Soil Survey

Russell County
Virginia

By
S. S. OBENSHAIN, in Charge, H. C. PORTER, W. W. LEWIS, and G. S. FRANCIS
Virginia Agricultural Experiment Station
and
R. C. JURNEY, A. C. ORVEDAL, R. E. DEVEREUX, and A. W. GOKE
United States Department of Agriculture

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ROBERT M. Salter, Chief

DIVISION OF SOIL SURVEY

CHARLES E. Kellogg, Head Soil Scientist, in Charge

VIRGINIA AGRICULTURAL EXPERIMENT STATION

A. W. Drinkard, Jr., Director

DEPARTMENT OF AGRONOMY

T. B. Hutcherson, Head

S. S. Oehsenhain, in Charge Soil Survey

and the

TENNESSEE VALLEY AUTHORITY
## SOIL SURVEY OF RUSSELL COUNTY, VIRGINIA

By S. S. OENBISHAIN, in Charge, H. C. PORTER, W. W. LEWIS, and G. S. FRANCIS, Virginia Agricultural Experiment Station, and R. C. Jurney, A. C. Orvedal, R. E. Deverczuk, and A. W. Goke, Division of Soil Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture

Area inspected by J. W. MOON, Principal Soil Scientist

United States Department of Agriculture in cooperation with the Virginia Agricultural Experiment Station and the Tennessee Valley Authority

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1 Report written by R. C. Jurney, Division of Soil Survey, Bureau of Plant Industry, Soils, and Agricultural Engineering.

2 The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.
HOW TO USE THE SOIL SURVEY REPORT AND MAP

The soil survey report and map of Russell County, Va., contain information—both general and specific—about the soils, crops, and agriculture of the county. They are prepared for the general public and are designed to meet the needs of numerous readers having varied interests. The individual reader may be interested in some particular part or in all of the report. Ordinarily he will not have to read the whole report to gain the information he needs.

Readers of the soil survey reports may be considered as belonging to three general groups: (1) Those interested in limited areas, such as communities, farms, and fields; (2) those interested in the county as a whole; and (3) students and teachers of soil science and related agricultural sciences. An attempt has been made to satisfy the needs of these three groups by making the report a comprehensive reference work on the soils and their relation to crops and agriculture.

Those readers whose chief interest is in limited areas, such as some particular locality, farm, or field, include farmers, agricultural technicians interested in planning operations in communities or on individual farms, real-estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. The first step of a reader in this group is to locate on the map the tract with which he is concerned. The second step is to identify the soils on the tract. This is done by locating in the legend on the margin of the map the symbols and colors that represent the soils in the area. The third is to locate the name of each soil in the table of contents, which refers the reader to the page or pages in the section on Soils and Crops where each soil is discussed in detail. Under the soil type heading he will find a description of the soil and a discussion of its suitability for use and its relations to crops and agriculture. He will also find useful information in the sections on Productivity Ratings and Physical Land Classification, Land Uses and Soil Management, and Water Control on the Land.

The second group of readers includes persons who are interested in the county as a whole, such as those concerned with land-use planning and the placement and development of highways, power lines, docks, urban sites, industries, community cooperatives, resettlement projects, private or public forest areas, recreational areas, and wildlife projects. The following sections of the report are intended for such users: (1) County Surveyed, in which such topics as physiography, vegetation, water supply, population, and cultural developments are discussed; (2) Agricultural History and Statistics, in which a brief history of the agriculture of the county is given and the present agriculture is described; (3) Productivity Ratings and Physical Land Classification, in which the productivity of the soils is given, a grouping of soils according to their relative physical suitability for agricultural use is represented, and a generalized land map is included; (4) Land Uses and Soil Management, in which the present use and management of the soils are described, their management requirements are discussed, and suggestions for improvement in management are made; and (5) Water Control on the Land, in which the problems pertaining to drainage and control of runoff, including control of accelerated erosion, are treated.
The third group of readers includes students and teachers of soil science and allied subjects, such as crops, forestry, animal husbandry, economics, rural sociology, geography, and geology. The teacher or student of soils will find the sections on Morphology and Genesis of Soils and Laboratory Determinations of special interest. He will also find useful information in the section on Soils and Crops, the first part of which presents the general scheme of classification and a discussion of the soils with regard to the county as a whole, and the second part of which presents a detailed discussion of each soil. If he is not already familiar with the classification and mapping of soils, he will find those subjects discussed in Soil Survey Methods and Definitions. The teachers of other subjects will find the sections on County Surveyed, Agricultural History and Statistics, Productivity Ratings and Physical Land Classification, and the first part of the section on Soils and Crops of particular value in determining the relations between their special subjects and the soils in this county. Soil scientists or students of soils as such will find their special interest in the sections on Morphology and Genesis of Soils and Laboratory Determinations.

COUNTY Surveyed

Russell County is in the southwestern part of Virginia (fig. 1.). It is separated from West Virginia, Kentucky, and Tennessee by a semicircle of other counties. The county is roughly rectangular in shape and is about 34 miles long and 15 miles wide. The longest dimensions are the northwestern and southeastern boundaries, which, for the most part, follow mountain ridges. The shortest dimensions are the northeastern and southwestern boundaries, which are approximately straight lines, except for a comparatively short distance in the extreme western part where the Clinch River forms the boundary. Lebanon, the county seat, is near the geographical center of the county and is about 120 miles by air line southwest of Roanoke and about 35 miles north of Bristol. The area of the county is 472 square miles, or 302,080 acres.

Russell County lies within the Valley and Ridge province of the Appalachian Highlands. It is divided by a broad lowland belt about 12 miles wide that extends in a northeast-southwest direction. It is a stretch of country consisting of alternate valleys and ridges. This belt is bordered on each side by comparatively high mountains and
plateau country. The valley floors range from about 1,400 feet above sea level on the Clinch River in the extreme western part to about 2,600 feet southwest of Lebanon near the headwaters of Moccasin Creek and Little Cedar Creek. The relief in the valley areas is moderately sloping or rolling to hilly and steep. The interstream ridges range from about 2,300 to 3,600 feet in elevation. Copper Ridge and Moccasin Ridge in the southwestern part are the most prominent ridges of the lowland belt. Copper Ridge ranges from about 2,400 to 2,800 feet above sea level. The crest of this ridge ranges from narrow to comparatively broad, and short spurs extend from it in some places. The sides of the ridge are comparatively steep and in places are cut by deep ravines. Moccasin Ridge ranges from about 2,300 to 2,800 feet in elevation. The crest of this ridge is narrow. For a considerable distance from southwest to northeast the trend is fairly straight, but in the northeastern part the ridge turns sharply. In many places the slopes of this ridge are steep, and in some places they are broken. River Mountain and House and Barn Mountain, in the eastern part, reach the highest elevations in the lowland belt. River Mountain ranges from about 2,500 to 3,250 feet and House and Barn Mountain from about 2,500 to 3,600 feet above sea level. These ridges are characterized by narrow crests and steep to rugged sides.

The valleys are mainly those made by the Clinch River and Cedar, Moccasin, Copper, and Indian Creeks. The relief of the uplands bordering these valleys is rolling to hilly, although it is steep where the streams have cut deep, narrow passageways. Comparatively smooth uplands are near and southwest of Castlewood and near Hansonville, Lebanon, Elk Garden, Old Rosedale, and Belfast Mills. Strips of almost level to undulating land, ranging from a few feet to nearly half a mile in width, are present as terraces or first bottoms near some streams. Close to the foot of some mountains and at the base of some slopes in the valleys are narrow to comparatively wide gently sloping areas. Limestone sinks, ranging from a few feet to several hundred feet in diameter, have formed in many places.

In the northern part of the county are areas that have been thoroughly dissected by streams, with the result that the land features consist of steep ridges and narrow valleys. There is practically no smooth upland or lowland in these areas. Divide Ridge, Buffalo Mountain, Brass Ridge, Flat Top Ridge, Sourwood Mountain, Hollow Poplar Ridge, Middle Ridge, Little Fork Ridge, and Hortons Ridge are in this part of the county. Pine Ridge, in the western part, is also prominent.

Sandy Ridge and Big A Mountain are in the extreme northern part, and the county line for the most part follows their crests. Sandy Ridge ranges from about 2,400 to 3,200 feet above sea level. The summit of this ridge is somewhat winding. Rising to an altitude of 3,735 feet, Big A Mountain is the highest mountain in the county north of the Clinch River.

Clinch Mountain is in the southeastern part, and its crest forms the dividing line between Russell County and Washington County and between Russell County and Smyth County. It is a well-defined ridge and ranges in elevation from about 3,000 to more than 4,000 feet. Middle Knob, one of the highest points on Clinch Moun-

* Elevations are from U. S. Geological Survey topographic maps.
tain, has an elevation of 4,208 feet, and Hayters Gap has an elevation of 3,017 feet above sea level. The northwest slope of the mountain southwest of Hansonville ranges from about 1/2 to 1 mile in width. Here the crest of the mountain is narrow and the trend is almost straight. The slope is steep and is dissected by many drainageways originating near the summit of the mountain. Eastward from a point near Hansonville the mountainside ranges in width from about 1/2 to 2 miles. It is steep and considerably dissected by drainageways, but near the base in places it becomes somewhat smoother. The crest of the mountain in this district is narrow and somewhat sinuous. Steep rock scarps appear in many places near the top. In the southeastern part Clinch Mountain Spur branches from the main ridge of Clinch Mountain and extends eastward into Tazewell County.

Beartown Mountain, with an elevation of 4,604 feet, stands near the southeastern corner. It is the highest mountain in the county. The crest is narrow, and the slopes, ranging in width from about 1/2 to 2 miles, are steep and in many places broken.

Elevations above sea level for some of the more important towns are as follows: Artrip 1,560 feet, Carterton 1,485 feet, Castlewood 1,477 feet, Cleveland 1,425 feet, Finney 1,588 feet, Hansonville 2,175 feet, Honaker 1,600 feet, Lebanon 2,131 feet, Swords Creek 1,861 feet, Belfast Mills, 2,280 feet, Candlewax 1,985 feet, Dante 1,704 feet, Elk Garden 2,131 feet, Putnam 1,878 feet, and Wilder 2,250 feet. The various elevations and the drainage system indicate that the general slope is southwestward.

Approximately 80 percent of the county is drained by the Clinch River, a tributary of the Tennessee River. The southwestern part is drained by Moccasin Creek and Copper Creek, and a comparatively small area in the extreme southeastern part is drained by Tumbling Creek, which breaks through Clinch Mountain and empties into the North Fork Holston River. The Clinch River flows in a southwesterly direction across the northern part of the county. The tributaries of the Clinch River flow in a transverse direction to the trend of the main lowland belt, and some of them break through the interposing knobs and ridges.

Numerous creeks and branches ramify practically all parts of the county and thus afford a complete drainage system for all the upland country. The only poorly drained areas are in low flat places near some of the streams. The many streams, together with numerous springs, furnish a sufficient supply of water for cattle during years of normal rainfall. Nearly every farm is situated so as to have access to one or more of these sources of water.

The streams have worn their channels to a depth of 300 to 500 feet below the general level of the nearby country. Rough and broken land lies adjacent to the Clinch River and large creeks in places where they cut across ridges. The streams are active and normally are dependable as sources of water power, which in some places is used for the operation of gristmills. The resources for water power, however, are not completely used. It is possible to develop water power along the Clinch River and along some of the creeks.

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Most of the mountains in the northern part of the county, considerable areas on the slopes of Clinch Mountain, and some of the steep ridges in the lowland belt are covered with forest. Most of the forests consist of second-growth trees. In the mountainous districts four associations of trees common to the Allegheny Mountain region are present. Hemlock is the most common tree on the bottom lands, but its distribution is limited, as it grows mainly in protected valleys near streams. White pine, sycamore, birch, and black tupelo (blackgum) grow in association with the hemlock in some localities. In the coves the forest is chiefly tuliptree, together with buckeye, cuckumbertree, basswood or linden ("linn"), walnut, white oak, and other fast-growing trees. The area occupied by these trees, however, is comparatively small. White oak, the most important tree commercially, occupies the greater part of the mountain forests. Toward the upper slopes chestnut and chestnut oak become more prominent. On the main ridges, spurs, and upper slopes is the ridge type of forest, composed of a mixture of chestnut and chestnut oak associated with scarlet oak, hickory, white oak, black locust, and pitch pine in places. Most ridges have an open forest, and the trees are crooked and limby. In these areas forest fires have been especially destructive.

In the mountainous districts mountain-laurel and huckleberries constitute a large part of the undergrowth. Broomsedge, other wild grasses, dewberries, blackberries, and sheep sorrel grow in some places.

In the intermountain country the trees include white oak, black oak, red oak, scarlet oak, black locust, walnut, poplar, dogwood, red maple, redcedar, hackberry, black gum, and sassafras. Dead chestnut trees are present in some of the forested areas. In places near streams willow and sycamore grow. Small native plants are crabgrass, foxtail, hawkweed, wild carrot, broomsedge, nettle, running briers, narrow- and broad-leaved plantain, wild strawberry, aster, oxeye daisy, goldenrod, dandelion, stickweed or ragweed, fleabane, yarrow, dewberries, blackberries, and sumac. Mint, reeds, and alder grow in many of the poorly drained places. Bluegrass is a widely distributed and important plant in the limestone areas.

In 1745 the trend of emigration from the Shenandoah Valley was toward the southwest, beyond the headwaters of the James River and to the sources of the Roanoke River. Soon a few of the harder settlers advanced as far as the New River and thence into the country to the southwest. In 1750, or perhaps earlier, surveys were made on the Clinch River and Moccasin Creek within the limits of the present Russell County. Early in 1748 the first recorded exploring party crossed the wilderness of southwestern Virginia and made surveys from the Allegheny Mountains to the Tennessee boundary. It is probable that this party reached the Clinch River Valley. Following this expedition, many pioneers proceeded as far as the New River, but the French and Indian War (1754–63) retarded settlement of the southwest country for many years. A number of veterans of this war made their homes in Russell County.

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Before the coming of settlers to the section in which Russell County is located, hunters roamed its forests, usually in parties and for a season. Occasionally a hunter would prolong his stay and gain a corn right, thus becoming a quasi settler. One such hunter, named Castle, kept his headquarters in the western part of the county and ranged the forests thereabout until the locality became known as Castle's Woods. Probably a few scattered homesteads were in the county prior to 1770, but the first permanent community established was known as Castle's Woods. Less extensive settlements, founded about the same time, are Moccasin, Elk Garden, and Glade Hollow (just northwest of Lebanon). A number of early settlers located on or near Cedar and Copper Creeks, and a few located in more remote places on Thompsons and Swords Creeks.

In 1773 permission was given by the county court to build a mill in the Castle's Woods settlement. This was the first mill noted in the official records. At an early date Jesses Mill was built on Mill Creek.

The encroachment of settlers on Indian domain and the impending settlement of Ohio and Kentucky aroused the Indians to resistance, and in 1773 increased depredations were made on the Virginia frontier. Four community forts were erected in Russell County for protection against bands of Indians. About the beginning of the Revolutionary War the Holston and Clinch settlements had trouble with the Ohio Indians and with the Cherokee Indians of the South. In the summer of 1776 a vigorous campaign was waged against the Cherokee, and the uprising was soon quelled. Nevertheless, atrocities continued to be committed by small bands of Indians. For many years after the white settlers came to the Clinch Valley, the Indians slew or captured hundreds of people and time after time wiped out whole families.

Russell County was formed from a part of Washington County in 1786. It was named for William Russell, one of the earliest settlers in Castle's Woods and a representative from Washington County in the House of Delegates at the time Russell County was formed. Through the formation of Russell County, Washington County lost the greater part of its territory, and Russell County embraced many times its present area. Parts were taken to form Lee County in 1792, Tazewell County in 1799, Scott County in 1814, Wise County in 1855, Buchanan County in 1858, and Dickenson County in 1880—the last change made in the boundaries of Russell County. The present county seat was established at Lebanon in 1818.

According to the Federal census of 1940, the population of the county was 26,827, all classed as rural. The population is densest in the northwestern and northeastern parts of the county, probably because of the coal mining in those parts. The northern, south-central, and southeastern parts are fairly well populated. The farming settlements are north of Honaker, in the vicinity of the Clinch River, and between the Clinch River and Clinch Mountain. Their distribution is determined largely by the character of the soil and the lay of the land. In the mountainous areas the population is confined mostly to the smoother areas in narrow valleys and to favorable places near the bases of mountains. Throughout the smoother areas of the lowland belt the population is fairly evenly distributed.
The early settlers were Scotch-Irish, and the present population is almost entirely native whites, mainly descendants of the pioneers. A very small percentage is foreign-born or of mixed parentage. Some Negroes live in the county. The composition of the population in 1940 was 97.1 percent native white, 2.7 percent Negro, and 0.2 percent foreign-born white.

There are no large towns, but many small settlements are in the coal-mining districts and scattered through the agricultural districts. According to the 1940 census, Lebanon, the county seat and an important local trading center, had a population of 622. The town is not situated on a railroad, but United States Highway No. 19 affords a transportation line. Dante, in the northwestern part, is the largest town in the county. It has a population of approximately 2,600. It is a coal-mining town, and its principal business centers in the production of coal. Honaker, the next largest town, with a population of 851, serves principally as a local trading center and shipping point. Other towns or villages located on a railroad are Cleveland, Clinchfield, Artrip, Carterton, Finney, Swords Creek, Putnam, Wilder, Blackford, Drill, and Carbo. These places are shipping points and trading places mainly in the coal-mining districts. Castlewood, in the western part, is an important local trading center in the agricultural district. Hansonville, Belfast Mills, and Dickinsonville are local trading places not on a railroad.

 Railroad facilities are ample for the northern part of the county but are lacking in the southern part. The Norfolk & Western Railway crosses the northern part. A branch line of this railway extends from Honaker to Garden in the extreme northern part, and one extends from Honaker to Blackford, a distance of about 5 miles. The Clinchfield Railroad cuts across the northwestern corner of the county. This railroad has a branch line that connects Carbo with Wilder, by means of the Norfolk & Western tracks, at St. Paul in Wise County.

Hard-surfaced highways extend into nearly all parts of the county, and most of the agricultural districts are accessible to one of them. United States Highway No. 19 crosses the southeastern part. In addition to the main highways, secondary soil, gravel, or sand-clay roads traverse practically all of the districts between the main highways. These roads are convenient to farmsteads, churches, and schools and furnish outlets to the main highways. The road system is maintained by the State, and the roads are kept in fair to good condition throughout the year.

Churches and schools are located at convenient places in the rural districts. Busses are used to convey the pupils to and from some of the schools. Rural mail routes extend to practically all parts of the county. Telephone service is available in many districts.

Cattle and sheep are the principal marketable agricultural products, and some hogs, chickens, dairy products, and tobacco are produced for sale on outside markets. All the heavy cattle are sold at Jersey City, N. J., and the lighter weight ones at Lancaster, Pa. Packers send representatives, who buy some cattle and ship them direct to the packing plants. Sheep and lambs are disposed of chiefly at markets in Jersey City, but some are handled cooperatively.
and shipped direct to packers. Wool is sold cooperatively to mills in North Carolina and Tennessee.

A few carloads of hogs are shipped to outside markets during the spring. Chickens and eggs are exchanged for merchandise in stores. Buyers of these products visit the stores once a week, and the chickens and eggs bought are transported by truck to outside markets. Milk is transported to Abingdon in Washington County and sold to a milk-condensing plant. Sour cream is shipped principally to creameries in Kentucky. The greater part of the tobacco grown is sold at Abingdon.

Coal mining is an important industry. About 84 square miles is underlain by bituminous coal. This area is a part of the vast coal fields in southwestern Virginia, which in 1926 yielded more than 14,000,000 tons of coal. The first commercial mines were opened in 1904 at Dante. Since 1910 coal has been mined in different parts of the county. In 1917 the combined production of the mines amounted to 2,000,540 tons, but in 1929 it was 1,414,677 tons, and in 1935, 660,424 tons.

There is a total thickness of about 3,000 feet of coal-bearing rocks in the county, and seven coal beds are 30 or more inches thick throughout large areas. The possible production of coal is estimated to be approximately 706,000,000 tons. The coal fields are favorably situated with respect to shipment to various markets. In 1928, of the 1,167 men employed at the coal mines, 287 worked on the surface, and in 1935, of the 983 men employed at the mines, 186 worked on the surface. The greater part of the coal is mined through drift openings.

Although coal is the predominant mineral resource, other minerals are present in small quantities. At times some of them have been mined, but at present no mining operations are carried on. A few prospects of manganese are known, the best of which is on Moccasin Ridge south of Castlewood. Barite is reported to exist from the Tazewell County line southwestward as far as Lebanon. This mineral was mined on the Clinch River near Gardners before 1900, and in 1906 the Russell-Tazewell field was the main source of barite in the State. Iron ore has been mined in small quantities for local smelting and for shipment. Forges in the early days smelted ore to a malleable iron, but the sources of the ore are not known. Iron ore from a mine about 6 miles southwest of Castlewood formerly was shipped to Big Stone Gap in Wise County for smelting. Deposits of lead and zinc lie along Copper Creek about 7 miles west of Hansonville. One mine containing the best ore was operated for a long time, but the long haul over poor roads to a railroad prevented free development of the field.

The clay deposits of the county have never been developed, but tests of shale exposed near Kiser indicate that the material is suitable for the manufacture of both common and face brick. Other exposures of clay are near Carterton, Castlewood, and Honaker. Material in the form of limestone and shale suitable for the manufacture of Portland cement underlies the slope of Clinch Mountain and adjacent territory, but it has never been exploited. Limestone suitable for building purposes, crushed stone, and lime is present in large areas,
but very little of it has ever been used except locally. This limestone has been an advantage, as it enabled the county to begin the building of hard-surfaced roads as early as 1807, and for many years it has been used for local building purposes and as a source of lime for use on agricultural lands. Sandstone occurring in the northern part of the county has been used in a small way for building material. Sand from sand deposits along the Clinch River and other large streams is used in local building. Gravel is present in several places, mainly along some of the ridges, and it is used for surfacing highways and in concrete mixtures. In the vicinity of Elk Garden there is a marble or high-grade crystalline limestone that takes a very good polish.

CLIMATE

The climate of Russell County is continental. The mean annual temperature is 54.5° F. Considerable variation in seasonal temperatures exists; the difference between the summer mean and the winter mean is 32.8°. Although there is a wide variation in temperature, the climate is fairly mild. The summers are comparatively short, and, although the temperature during the day may be rather warm, the nights are usually cool.

Elevations within the county range from about 1,400 to 4,700 feet above sea level, and differences in altitude cause differences in temperature. The cold is less severe in the protected valleys than on the ridges. Freezing takes place a little earlier in the mountains than in the lowland belt. Outdoor work can be performed during the winter except on extremely cold days. The winters are too severe for the growing of oats, although winter oats are sown to a small extent in mixtures for use as feed. Wheat is grown, but on northerly exposed slopes it is severely injured by freezes. Hardy vegetables, such as turnips and kale, are grown. The grazing season extends from about April 15 to November 15. On the higher slopes in the mountains grazing starts a little later in the spring and ends a little earlier in the fall than in the lower lying country.

Killing frost has been recorded as late as May 27 and as early as September 24. The average frost-free season is 178 days, which is sufficient time for the commonly grown crops to mature.

The average annual rainfall is 50.82 inches. The greatest amount of rainfall is in the spring and summer, and it is sufficient for the crops grown. The rains come as well-distributed showers, favorable to the growth of crops and pasture grasses in most seasons. Serious storms have not occurred in this county. Hailstorms occur occasionally, but the damage done is slight. During the 22-year period from 1918 to 1939 the average number of rainy days a year was 139 and of clear days 137.

Table 1, compiled from the records of the United States Weather Bureau station at Dante, gives the normal monthly, seasonal, and annual temperature and precipitation, which are representative of practically all sections of the county.
Table 1.—Normal monthly, seasonal, and annual temperature and precipitation at Dunite, Russell County, Va.

(Elevation, 2,000 feet)

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature Mean °F.</th>
<th>Absolute maximum °F.</th>
<th>Absolute minimum °F.</th>
<th>Precipitation Mean Inches</th>
<th>Total for the driest year (1890) Inches</th>
<th>Total for the wettest year (1890) Inches</th>
<th>Average snowfall Inches</th>
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</thead>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>December</td>
<td>38.3</td>
<td>70</td>
<td>-13</td>
<td>3.91</td>
<td>1.33</td>
<td>2.10</td>
<td>3.7</td>
</tr>
<tr>
<td>January</td>
<td>35.7</td>
<td>70</td>
<td>-5</td>
<td>3.04</td>
<td>3.35</td>
<td>3.98</td>
<td>5.9</td>
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<tr>
<td>February</td>
<td>39.4</td>
<td>77</td>
<td>3</td>
<td>3.42</td>
<td>3.18</td>
<td>3.46</td>
<td>3.1</td>
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<tr>
<td>Winter</td>
<td>37.8</td>
<td>77</td>
<td>-13</td>
<td>11.27</td>
<td>7.83</td>
<td>9.82</td>
<td>12.7</td>
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<tr>
<td>March</td>
<td>45.1</td>
<td>87</td>
<td>2</td>
<td>4.84</td>
<td>2.45</td>
<td>6.00</td>
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<td>April</td>
<td>54.1</td>
<td>91</td>
<td>13</td>
<td>4.14</td>
<td>3.81</td>
<td>5.53</td>
<td>1.1</td>
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<tr>
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<td>61.1</td>
<td>88</td>
<td>24</td>
<td>5.24</td>
<td>1.82</td>
<td>9.80</td>
<td>(v)</td>
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<tr>
<td>Spring</td>
<td>63.4</td>
<td>91</td>
<td>2</td>
<td>14.23</td>
<td>7.68</td>
<td>19.33</td>
<td>2.7</td>
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<tr>
<td>June</td>
<td>68.9</td>
<td>95</td>
<td>37</td>
<td>4.95</td>
<td>5.47</td>
<td>5.11</td>
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</tr>
<tr>
<td>July</td>
<td>71.8</td>
<td>98</td>
<td>44</td>
<td>5.44</td>
<td>2.59</td>
<td>6.79</td>
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<tr>
<td>August</td>
<td>71.0</td>
<td>98</td>
<td>44</td>
<td>4.94</td>
<td>1.65</td>
<td>2.67</td>
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<tr>
<td>Summer</td>
<td>70.6</td>
<td>98</td>
<td>37</td>
<td>13.34</td>
<td>10.01</td>
<td>14.47</td>
<td>0.0</td>
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<tr>
<td>September</td>
<td>67.2</td>
<td>98</td>
<td>30</td>
<td>3.93</td>
<td>1.22</td>
<td>4.51</td>
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<tr>
<td>October</td>
<td>58.1</td>
<td>89</td>
<td>19</td>
<td>3.04</td>
<td>7.46</td>
<td>5.47</td>
<td>0.8</td>
</tr>
<tr>
<td>November</td>
<td>45.1</td>
<td>77</td>
<td>-2</td>
<td>2.07</td>
<td>3.82</td>
<td>4.99</td>
<td>1.1</td>
</tr>
<tr>
<td>Fall</td>
<td>56.1</td>
<td>99</td>
<td>-2</td>
<td>9.99</td>
<td>12.50</td>
<td>14.97</td>
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<td>Year</td>
<td>54.5</td>
<td>99</td>
<td>-13</td>
<td>50.82</td>
<td>38.02</td>
<td>68.29</td>
<td>17.5</td>
</tr>
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</table>

1 Trace.

AGRICULTURAL HISTORY AND STATISTICS

In the early days agriculture was diversified and practically self-sustaining. It furnished almost all of the food and clothing for the people and feed for the livestock. The Federal census of 1850 shows that the agriculture consisted of growing corn, wheat, and oats and raising livestock. In addition to these, rye, buckwheat, tobacco, wool, peas, beans, potatoes, butter, cheese, clover seed, hay, flax, flaxseed, maple sugar, molasses, honey, and beeswax were a part of the agricultural products.

In the early days flax, flaxseed, maple sugar, molasses, and honey were of much more importance than they are today. In 1850 the county was foremost in the State in the production of flax, the fiber marketed totaling 50,589 pounds. The growing of this crop in the county, as well as in the State, had almost been discontinued by 1890, as only 525 pounds of fiber were produced in the county that year. The production of flaxseed in 1850 was 1,926 bushels, but in 1880 it had declined to 280 bushels. In 1850, 61,944 pounds of maple sugar were produced, and in 1890 only 450 pounds. In 1850, the production of molasses was 1,347 gallons, and in 1880 it reached a peak of 29,329 gallons. In 1860, 29,693 pounds of honey were produced, and in 1880, 49,409 pounds—the largest yield on record.

Corn has always been the principal crop. It was used extensively for both man and livestock in the early days of agriculture and has continued to be of great importance as feed for livestock. In 1850 the corn crop amounted to 378,919 bushels. Not enough corn is grown for
local needs. A few carloads are shipped in from distant points, and
some is brought in from Washington County. A few carloads of
cottonseed meal are used yearly as feed to supplement the supply of
corn. The greater part of the corn produced is grown on land that
has been fertilized.

The production of wheat, although important, has never been large.
This crop, however, has been grown since the early days for a home
supply of flour, and, in 1850, 25,604 bushels were harvested. At
present not enough wheat is threshed to supply home needs. Some
of the larger farms produce enough to sell to the local mills, but most
of the wheat ground at the mills comes from the West. Some wheat
is fed in the sheaf to cattle, and some is grown in mixtures of small
grains as feed for cattle. Oats were one of the early crops, and, in
1850, 154,305 bushels were produced. At present the quantity of oats
produced is much less than in 1850.

Tobacco has been grown since the days of the early settlers. It was
used as partial pay for the county officers. For many years, however,
it was produced in small quantities mainly for home use. In 1850,
7,577 pounds of tobacco were grown, but in 1910 the quantity produced
was only 2,147 pounds. About 1920 burley tobacco was introduced,
and its culture has spread rapidly. In 1940 tobacco was grown on
1,756 farms. The tobacco fields range in size from $\frac{1}{2}$ to 3 acres and
average about 1 acre. The average yield of tobacco is about 1,200
pounds an acre, and some of the highest yields range from about 1,800
to 2,000 pounds. Commercial fertilizer and stable manure are used
in growing tobacco.

There are a few commercial apple orchards, and the main variety
of apples grown is the York Imperial. Stark (Stark Delicious) and
Ben Davis are minor varieties produced. Peaches are grown to some
extent in connection with the apple orchards. Almost every farm
has a small orchard of apple trees for home use, and in addition some
farms have peach, pear, and cherry trees.

Most of the farms have vegetable gardens, in which string beans,
tomatoes, cabbage, and sweet corn are grown. In a few gardens
beets, sweet peppers, carrots, parsnips, and celery are grown. String
beans are grown for sale on a few acres in the Castlewood district.

For a long time the quantity of dairy products has been very little
more than that needed for home use. As early as 1850 the quantity
of butter produced was 102,478 pounds. In that year 10,280 pounds
of cheese were produced. In 1929, 2,159,120 gallons of milk and 509,-
145 pounds of butter were produced, and in 1939 the production was
2,141,013 gallons of milk and 564,039 pounds of butter. Dairying
did not expand until recently because there was no nearby or con-
venient outlet for an appreciable part of the products. The estab-
ishment of a milk-condensing plant at Abingdon a few years ago
created an interest in dairying and gave impetus to the production
of milk. Trucks operating in the county collect an average of 6,000
pounds of milk a day from about 160 farms. At times as much as
8,000 pounds of milk a day are collected from 215 farms.

Bluegrass has always held an important place in the agriculture of
the county. It was considered a pest by the early settlers. It

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*PERKINS, W. R., SOME RESULTS OF FERTILIZER, FIELD CROP VARIETIES, ROTATION, PASTURE,
PERMANENT MEADOW, AND ALFALFA EXPERIMENTS. Va. Agr. Exp. Sta. (Washington County
Sta.), 10 pp. 1938. [Mimeographed.]*
appeared as soon as clearings in the wilderness were made for the planting of crops. The early settlers with primitive tools endeavored to rid the fields of the grass by digging and piling it on stumps and rocks to dry and even by burning it in attempts to destroy the seed. Nevertheless, the grass soon spread over fields that were left uncultivated. As the cattle grazing on this grass became fat, the early settlers soon realized that bluegrass made excellent pasture for cattle. As a result the pasture areas were extended, and the grazing possibilities attracted new settlers. Many forests were cleared and were succeeded by a mantle of grass that covered much of the valleys, hills, and mountainsides. Russell County eventually became one of the foremost counties in the State for livestock raising.

The Scotch-Irish pioneers took special interest in cattle and sheep, and the bluegrass afforded an excellent basis for raising them. The first cattle were brought from the eastern part of Virginia. They were not of particularly good quality; therefore, between the years 1840 and 1850, purebred Shorthorns were introduced from Kentucky to improve the increasing herds. From 1855 up to the time of the Civil War the herds improved. According to the Federal census of 1850, there were 19,969 cattle in the county, of which 4,615 were milk cows and 389 were oxen. The 1870 census showed that the number of cattle had decreased to 10,322, which included 2,874 milk cows and 334 oxen. About the year 1895 white-faced cattle (Herefords) were introduced, coincident with a greater interest in cattle raising. According to the census of 1900, the number of cattle in the county was 24,199. On April 1, 1940, cattle over 3 months of age numbered 20,840, of which 5,650 were milked in 1939. Beef cattle are mainly Hereford and Shorthorn, although a few are Aberdeen Angus. The Jersey is the principal dairy cow. The dairy herds range in size from 10 to 25 cows. Four dairy farms are operated in the county. Many cattle are bought elsewhere to stock the farms. About 5,000 calves are shipped annually from Texas alone.

Sheep raising for a long time has been fairly important. According to the 1850 census, the county had 21,442 sheep in that year. The number declined thereafter, but in 1900 the census showed an increase to 25,646 sheep. The peak was reached in 1910, when 43,799 sheep were reported, including spring lambs. On April 1, 1940, the county had a total of 27,915 sheep over 6 months of age, and it ranked second to Augusta County in number of sheep. The sheep are mostly of the Hampshire and Southdown breeds. Some of the best lambs sold on the eastern markets are raised in this county.

According to the early records, some farms kept 25 to 30 horses, or even more. According to the Federal census of 1850, the number of horses was 3,427 and the number of asses and mules 211. In 1910 horses numbered 4,830 and mules 984. The number of both horses and mules declined steadily until in 1940 there were only 3,442 horses and 292 mules. The work animals are predominantly horses—principally Belgians and Percherons. Not enough horses are raised in the county for local needs, and many are shipped in from the West.

Hog raising has been on the decline for a long time. In 1850 the number of hogs was 24,645, but by 1940 the number had dwindled to 5,888. The hogs are chiefly Poland China, and there are some Hampshire and Berkshire. Most of the farms have always had
flocks of chickens. The 1940 census reported 99,756 chickens and 1,598 turkeys on farms. Some farms keep ducks, geese, guinea fowls, and peafowls.

Originally Russell County was practically covered with forest. Removal of the virgin timber started when the pioneers began deadening the trees and clearing the land for crops and pastures. This practice continued over a long period. Logrollings brought together men who piled logs into great heaps to be burned so that more land might be available for use. Some of the timber was used in constructing and furnishing the farm buildings, making tools, and heating homes.

In the mountainous sections, because of the inaccessibility and undesirability of the soil for agricultural use, the forests were exploited very little until the coming of the railroad about 1890. Before this time only pine, walnut, and tuliptree (poplar) were removed. Logs were hauled to Abingdon, the nearest point on a railroad. After the Norfolk & Western Railway was built, numerous sawmills began operation. About the year 1904 coal mining began, and it soon became important. Much timber was cut in the mountains for use in the mines. Few trees were left, and many were destroyed by fires, which were frequent on the mountain slopes. Only a few sawmills are now in operation—principally in the mountains. There are no wood-using industries. The main forest products are mine props, posts, extract bark, and extract wood. Large tracts of cut-over timberland and coal land are in single holdings, some as much as several thousand acres in size.

Table 2, compiled from the reports of the United States census, shows the acreage of most of the crops in stated years.

**Table 2.—Acreages of the principal crops grown in Russell County, Va., in stated years**

<table>
<thead>
<tr>
<th>Crop</th>
<th>1870</th>
<th>1889</th>
<th>1899</th>
<th>1909</th>
<th>1919</th>
<th>1929</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For grain</td>
<td>10,020</td>
<td>20,158</td>
<td>22,465</td>
<td>22,536</td>
<td>24,900</td>
<td>17,368</td>
<td>19,562</td>
</tr>
<tr>
<td>For other purposes</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Oats</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Threshed</td>
<td>6,619</td>
<td>7,933</td>
<td>4,968</td>
<td>4,827</td>
<td>5,300</td>
<td>653</td>
<td>218</td>
</tr>
<tr>
<td>Cut and fed unthreshed</td>
<td>3,828</td>
<td>7,844</td>
<td>3,838</td>
<td>3,869</td>
<td>5,092</td>
<td>5,700</td>
<td>226</td>
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<tr>
<td>Wheat</td>
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<tr>
<td>Rye</td>
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<td>32</td>
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<tr>
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<td>265</td>
<td>21</td>
<td>30</td>
<td>6</td>
<td>6</td>
<td>32</td>
<td>25</td>
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<tr>
<td>All hay</td>
<td>3,988</td>
<td>9,434</td>
<td>8,101</td>
<td>10,711</td>
<td>12,980</td>
<td>14,653</td>
<td>12,577</td>
</tr>
<tr>
<td>Timothy and timothy and clover</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Mixed</td>
<td></td>
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</tr>
<tr>
<td>Clover alone</td>
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<tr>
<td>Alfalfa</td>
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<tr>
<td>Legoemes cut for hay</td>
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<td>Grains cut green</td>
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<td>Other tame hay</td>
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<td>Wild grasses</td>
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<td>Potatoes</td>
<td>126</td>
<td>140</td>
<td>268</td>
<td>400</td>
<td>279</td>
<td>380</td>
<td>423</td>
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<td>140</td>
<td>268</td>
<td>400</td>
<td>279</td>
<td>380</td>
<td>423</td>
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<td>12</td>
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<td></td>
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<tr>
<td>Peaches</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>Cherries</td>
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<td></td>
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</tr>
</tbody>
</table>

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1 For the year 1890.  
2 For the year 1930.  
3 For the year 1960.  
4 For the year 1860.  
5 For the year 1880.  
6 For the year 1890.  
7 For the year 1900.  
8 For the year 1910.  
9 For the year 1920.  
10 For the year 1930.  
11 For the year 1940.
According to the Federal census, the value of domestic animals, chickens, and bees on farms on April 1, 1940, was $1,384,762, and the value of agricultural products in 1939 was $2,645,974, of which field and orchard crops, vegetables, and products of farm gardens represented $1,539,325, livestock products $1,093,944, and forest products sold $13,401.

According to the 1940 census, 1,927 farms, or 64.3 percent of the total number of farms, reported the purchase of fertilizer in 1939, amounting to $58,624, or an average of $32.09 a farm reporting; in addition 51 farms reported the purchase of liming materials, amounting to $2,272. The total expense for fertilizer reported in the 1880 census was only $2,568. Commercial fertilizers are applied, among which are 3-8-5, 4-8-6, 4-12-4, 5-7-5, 0-12-4, and 0-14-6 grades and 20 percent superphosphate. A few farmers apply cottonseed meal to the land. Stable manure is used on the land in all available quantities. Liming is practiced on about 400 farms. The soil on many of the farms is enriched by the growing of clover or other legumes.

In 1939 feed was purchased on 1,296 farms, or 45.6 percent of all farms, at a total expense of $54,777, or an average of $42.27 a farm reporting. Farm help is plentiful and fairly efficient. Practically all of the laborers are white. In 1939 labor was hired on 778 farms, or 27.4 percent of all the farms. The total outlay for this purpose was $95,598, or an average of $122.88 a farm reporting. Other important expenses on farms in that year were as follows: Building materials on 798 farms, $55,755; implements and machinery on 249 farms, $41,766; and gasoline and other fuel on 1,195 farms, $23,764.

In 1880, according to the Federal census, 283,178 acres, or 89.2 percent of the area of the county, were included in 1,350 farms, averaging 209.8 acres in size. Of the land in farms, 108,719 acres were improved (cropland or plowable pasture). By 1940 the area in farms had decreased to 257,001 acres, or 83.1 percent of the total area. Although the number of farms increased to 2,340, the average size was only 90.5 acres. Cropland totaled 48,856 acres, of which cropland harvested in 1939 represented 46,534 acres, land on which crops were a failure 389 acres, and idle or fallow cropland 1,933 acres. Plowable pasture land occupied 65,886 acres. The total area of improved land, 114,542 acres, was slightly larger than in 1880. Woodland amounted to 60,891 acres, and other land in farms to 82,068 acres. The remaining 52,119 acres in the county not reported as farms probably includes forested and coal land in the mountainous districts.

Permanent pastures are confined largely to the steeper lands and stony areas in the lowland belt and to mountain slopes underlain by mixed limestone and shale. Most of the woodland areas of the farms are on the narrow ridge crests, steepest slopes, and rocky areas that are fairly steep or steep. In the mountainous districts in the northern part of the county some small areas are in pasture. Because of the steepness of slope and the presence of stones in many places, farming operations in the mountains are confined to less stony areas, to smooth areas on the tops of ridges, and to the milder slopes and bottoms near streams.

* Percentages, respectively, of nitrogen, phosphoric acid, and potash.
The census of 1940 reports that 67.3 percent of the farms are operated by owners, 32.6 percent by tenants, and 0.1 percent by managers. A large percentage of the tenants rent on a crop-sharing basis. When the landlord furnishes the work animals, fertilizer, and tools, the tenant receives one-third of the corn, one-third of the wheat, and one-half of the tobacco. The tenant does not get a share of the hay, as hay is produced on a daily wage basis. Some tenants are allotted enough corn for their own use and are paid a specified cash rate for the rest of the corn produced, which is fed to the landowner's cattle. Some pastures rent for cash at the rate of $1 to $1.50 a month for each head of cattle. Another pasture-rental plan is based on weight gained by the cattle in grazing, and the rental under this plan depends on the current price of cattle.

Many of the farm homes are large and substantial. In general the barns are of good construction and ample for the needs of livestock and for storage purposes. Farm equipment generally includes a wagon, two 2-horse turning plows, mowing machine, hay rake, disk harrow, one-row or two-row corn planter, cultivator, drag harrow, rock sled, and hand tools. A few farms have corn binders. Grain binders are operated on a community basis, and threshing machines are moved from place to place to thresh the grain.

Fields and pastures are fenced. A fence in wide use is made of woven wire with a few strands of barbed wire at the top. Other fences are constructed entirely of barbed wire, and a few are made of wooden rails.

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, gullies, ditches, pits, and other excavations, 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 is determined by simple tests. The drainage, both internal and external, and other external features, such as stoniness and the relief, or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon the features that influence 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 principal three of which 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

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*The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates neutrality, higher values indicate alkalinity, and lower values indicate acidity. Indicator solutions are used to determine the reaction of the soil, and dilute hydrochloric acid is used to detect carbonates of calcium (lime) and magnesium.
as (4) a complex. Some areas of land, 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, the same natural drainage conditions, and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may differ within a series. The soil series are given names of places or geographic features near which the soils were first found. Hagerstown, Clarksville, and Westmoreland are names of important soil series in Russell 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, Muskingum loam and Muskingum very fine sandy loam are soil types within the Muskingum series. Except for the texture of the surface soil, these soil types have approximately the same internal characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, differing from the type in some soil characteristic that may have 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 soil type, certain areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though no important differences may be apparent in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated plants. The more shallow or eroded parts of the soil type may be segregated on the map as a shallow or eroded phase.

The soil surveyors make a map of the county or area, showing the location of each soil type, phase, complex, and miscellaneous land type, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

**SOILS AND CROPS**

In Russell County the soil is generally composed of a light- to heavy-textured surface soil and a heavier textured subsoil. The subsoil ranges in color from brownish yellow to brownish red and in structure and consistence from friable and brittle to tough and plastic. Below the subsoil, which is about 1 to 3 feet thick, the soil material of mixed colors is composed of decomposed rock material that in most places is friable and crumbly. The surface soil ranges from about 6 to 10 inches in thickness and is light grayish yellow, brown, or dark brown. In texture the surface soil is prevailingliy fine and con-
sists of silt loam, silty clay loam, loam, very fine sandy loam, or fine sandy loam. No large areas of heavy intractable soil or large areas of deep, highly leached sandy soil have developed. Many rock fragments, ranging from small angular stones to boulders, are present on the soils in some of the mountainous areas and in many places at the base of mountains. Small angular fragments of chert, in places larger fragments, as well as fragments of sandstone, are scattered on the surface and embedded in the soil on some of the ridges in the limestone belts.

The soils developed over limestone are generally deep and have the smoothest surface, as the limestone, being less resistant to weathering, has dissolved readily. In general, these soils contain more plant nutrients than the soils underlain by shale or sandstone.

The soils developed over shale or sandstone generally are not so deep as those developed over limestone. Owing to the resistance of the bedrock to the agencies of weathering or to the steepness of slope, such soils are generally shallow. These soils also have a low content of mineral plant nutrients in comparison with the soils developed from the residuum of weathered limestone.

The rocks not only have furnished the material for the various soils but, because of their varying resistance to the forces of weathering have also caused much inequality in the surface of the land, ranging from smooth to hilly, steep, and broken. The mountains owe their existence to the hardness and resistance to weathering of the sandstone and other rocks that underlie them. The lowland belt owes its smooth surface to the fact that limestone dissolves readily. The shale, sandstone, and chert present with limestone in the lowland belt, because they are relatively insoluble, are largely responsible for the ridges in the limestone country. The rock formations are not everywhere covered with soil, and there are numerous small exposures of limestone. On mountain slopes in many places there are small outcrops of sandstone and in some places comparatively large areas of bare rock. Rather large areas of comparatively uniform soil have developed over the various rock formations, but, where the relief is hilly and steep, minor differences in soils appear, especially in the thickness of the surface soil and the subsoil.

The reaction ranges from slightly acid to strongly acid, except in the bottoms near streams and in a few areas underlain by limestone. Most of the soils are comparatively low in important nutrients, including nitrogen, phosphorus, potash, lime, magnesium, and others, although the soils over limestone and those of the bottom lands generally are richer in these nutrients than are the soils over sandstones and shales.

Many of the soils on the uplands do not contain a large quantity of organic matter. In forested areas a small quantity of dark-colored vegetable matter, derived mainly from the decay of leaves and twigs, is mixed in the topmost inch or two of the surface soil. In some pastures grass has contributed a small quantity of vegetable material to the upper part of the surface soil. Brown soils derived from alluvial material near streams and those formed from colluvial material near the bases of slopes and in depressions apparently contain a moderate quantity of well-decomposed organic matter in the surface soil.
Part of a limestone valley, showing typical association of soils: **Gs**, Greendale silt loam; **Hsn**, Hagerstown silt loam, rolling phase; **Hsl**, Hagerstown silt loam, hilly phase; **Hc**, Hagerstown stony silt loam; **Ls**, Litz shaly silt loam; **Rol**, rolling stony land (limestone material); **Ws**, Westmoreland silt loam. A small moderately eroded area, a small severely eroded area, limestone outcrops, a spring, and a nonarable sink are indicated by symbols as used on the soil map.
One of the productive parts of the county showing an association of soils characteristic of the north slopes and adjacent valley floors of Clinch Mountain. The soils shown are as follows: Bs, Bland stony silt clay loam, steep phase; Bc, Burgin silty clay loam; Cen, Calhoun silty clay loam, rolling phase; Hc, Hagerstown stony silty clay loam; Lv, Lebrew very fine sandy loam; Psn, Pisgah silt loam, rolling phase; RsL, rolling stony land (limestone material); RsM, rough stony land (Muskfragum soil material); Wc, Westmoreland silty clay loam, very steep phase. A sandstone escarpment is shown by symbol.
Erosion of the surface soil and gullying have not affected such extensive areas as in some sections that have much milder relief. Over much of the cleared land the soil has been protected by a cover of grass. Erosion is active in small areas, however, on nearly every farm, and it has become a serious problem on some farms.

In the lowland belt the cropland consists mainly of soils underlain by limestone, soils at the foot of slopes formed of colluvial material, and soils on terraces and first bottoms near streams (pls. 1 and 2). Because of their comparatively smooth surface, good tilth, and good physical qualities throughout, these soils dominate the agriculture of the county. The crops are grown on land ranging from nearly level, as on the bottoms near streams, to slopes as steep as 30 percent or more.

A definite relationship exists between the soils and the crops to which they are adapted. In order to show this relationship the soils are placed in five groups as follows: First-class soils, Second-class soils, Third-class soils, Fourth-class soils, and Fifth-class soils. The First-, Second-, and Third-class soils are used extensively for crops; the Fourth-class soils are commonly used for permanent pasture; and the Fifth-class soils are used mainly for forest.

In the following pages the soils of Russell County are described in detail, and their agricultural importance is discussed; their distribution in the county is shown on the accompanying soil map, and their acreage and proportionate extent are given in table 3.

### Table 3. — Acreage and proportionate extent of the soils mapped in Russell County, Va.

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Acres</th>
<th>Percent</th>
<th>Soil type</th>
<th>Acres</th>
<th>Percent</th>
</tr>
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</tr>
<tr>
<td>Burgin silt loam, slope phase</td>
<td>128</td>
<td>(i)</td>
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</tr>
<tr>
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<td>1.5</td>
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<td>1.5</td>
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<tr>
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<tr>
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<td>(i)</td>
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<td>0.8</td>
<td>Hazard silt loam, slope phase</td>
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<tr>
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<td>Holton silt loam</td>
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<td>0.3</td>
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<tr>
<td>Decatur silt loam</td>
<td>192</td>
<td>0.1</td>
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</tr>
<tr>
<td>Decatur silt loam, hilly phase</td>
<td>128</td>
<td>(i)</td>
<td>Huntington silt loam</td>
<td>358</td>
<td>0.1</td>
</tr>
<tr>
<td>Dunmore silt loam</td>
<td>1,408</td>
<td>0.5</td>
<td>Jefferson fine sandy loam</td>
<td>192</td>
<td>0.1</td>
</tr>
<tr>
<td>Dunmore silt loam, hilly phase</td>
<td>2,048</td>
<td>0.7</td>
<td>Jefferson fine sandy loam, hilly phase</td>
<td>412</td>
<td>1.5</td>
</tr>
<tr>
<td>Elliff cherty silt loam</td>
<td>704</td>
<td>0.3</td>
<td>Jefferson fine sandy loam, hilly phase</td>
<td>412</td>
<td>1.5</td>
</tr>
<tr>
<td>Elliff cherty silt loam, steep phase</td>
<td>4,909</td>
<td>1.6</td>
<td>Jefferson fine sandy loam, hilly phase</td>
<td>412</td>
<td>1.5</td>
</tr>
<tr>
<td>Elliff silt loam</td>
<td>2,498</td>
<td>0.8</td>
<td>Jefferson fine sandy loam, hilly phase</td>
<td>412</td>
<td>1.5</td>
</tr>
<tr>
<td>Elliff silt loam, hilly phase</td>
<td>448</td>
<td>0.1</td>
<td>Lindsley silt loam</td>
<td>1,728</td>
<td>0.6</td>
</tr>
<tr>
<td>Emory silt loam</td>
<td>832</td>
<td>0.3</td>
<td>Lindsley silt loam</td>
<td>1,728</td>
<td>0.6</td>
</tr>
</tbody>
</table>

1 Less than 0.1 percent.
TABLE 3.—Acreage and proportionate extent of the soils mapped in Russell County, Va.—Continued

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litt shaly silt loam, hilly phase</td>
<td>320</td>
<td>.1</td>
</tr>
<tr>
<td>Lodi loam</td>
<td>512</td>
<td>.2</td>
</tr>
<tr>
<td>Lodi loam, hilly phase</td>
<td>4,860</td>
<td>1.5</td>
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<tr>
<td>Lodi loam, steep phase</td>
<td>3,004</td>
<td>1.3</td>
</tr>
<tr>
<td>Malvin silty clay loam</td>
<td>2,752</td>
<td>.9</td>
</tr>
<tr>
<td>Mine dumps</td>
<td>64</td>
<td>(i)</td>
</tr>
<tr>
<td>Montevallo shaly silt loam</td>
<td>3,712</td>
<td>1.2</td>
</tr>
<tr>
<td>Muskimgum loam</td>
<td>24,832</td>
<td>8.2</td>
</tr>
<tr>
<td>Muskimgum loam, very steep phase</td>
<td>17,084</td>
<td>6.0</td>
</tr>
<tr>
<td>Muskimgum very fine sandy loam</td>
<td>64</td>
<td>(i)</td>
</tr>
<tr>
<td>Muskimgum very fine sandy loam, hilly phase</td>
<td>64</td>
<td>(i)</td>
</tr>
<tr>
<td>Muskimgum stony loam</td>
<td>11,712</td>
<td>3.9</td>
</tr>
<tr>
<td>Muskimgum stony very fine sandy loam</td>
<td>3,712</td>
<td>1.2</td>
</tr>
<tr>
<td>Phiplo fine sandy loam</td>
<td>576</td>
<td>2.2</td>
</tr>
<tr>
<td>Pishag silt loam</td>
<td>64</td>
<td>(i)</td>
</tr>
<tr>
<td>Pishag silt loam, hilly phase</td>
<td>330</td>
<td>.1</td>
</tr>
<tr>
<td>Pishag silt loam, rolling phase</td>
<td>512</td>
<td>.2</td>
</tr>
<tr>
<td>Pope fine sandy loam</td>
<td>900</td>
<td>.3</td>
</tr>
<tr>
<td>Pope sandy loam</td>
<td>448</td>
<td>.1</td>
</tr>
<tr>
<td>Pope silt loam</td>
<td>448</td>
<td>.1</td>
</tr>
<tr>
<td>Rock outcrop</td>
<td>256</td>
<td>.1</td>
</tr>
<tr>
<td>Rollingstone loam (limestone material)</td>
<td>9,152</td>
<td>3.0</td>
</tr>
<tr>
<td>Rough stony loam (limestone material)</td>
<td>21,568</td>
<td>7.2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Soil type</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rough stony land (Muskimgum soil material)</td>
<td>8,064</td>
<td>2.7</td>
</tr>
<tr>
<td>Squatchie loam</td>
<td>192</td>
<td>.1</td>
</tr>
<tr>
<td>Squatchie loam, slope phase</td>
<td>138</td>
<td>(i)</td>
</tr>
<tr>
<td>Tumbesilty clay loam, rolling phase</td>
<td>64</td>
<td>(i)</td>
</tr>
<tr>
<td>Upshur-Litz shaly silt loams, steep phases</td>
<td>384</td>
<td>.1</td>
</tr>
<tr>
<td>Upshur-Litz silt loams</td>
<td>9,344</td>
<td>3.1</td>
</tr>
<tr>
<td>Upshur-Litz silt loams, steep phases</td>
<td>1,024</td>
<td>.3</td>
</tr>
<tr>
<td>Upshur-Litz silt loams, steep phases</td>
<td>8,000</td>
<td>2.7</td>
</tr>
<tr>
<td>Wellston loam</td>
<td>128</td>
<td>(i)</td>
</tr>
<tr>
<td>Wellston loam, hilly phase</td>
<td>1,506</td>
<td>.5</td>
</tr>
<tr>
<td>Westmoreland silt loam</td>
<td>15,808</td>
<td>5.3</td>
</tr>
<tr>
<td>Westmoreland silt loam, rolling phase</td>
<td>320</td>
<td>.1</td>
</tr>
<tr>
<td>Westmoreland silt loam, very steep phase</td>
<td>4,100</td>
<td>1.4</td>
</tr>
<tr>
<td>Westmoreland silt loam, hilly phase</td>
<td>6,720</td>
<td>2.2</td>
</tr>
<tr>
<td>Westmoreland silt loam, very steep phase</td>
<td>704</td>
<td>.2</td>
</tr>
<tr>
<td>Westmoreland silt loam, very steep phase</td>
<td>2,368</td>
<td>.8</td>
</tr>
<tr>
<td>Total</td>
<td>302,080</td>
<td>100.0</td>
</tr>
</tbody>
</table>

1 Less than 0.1 percent.

Although the First-, Second-, and Third-class soils may be considered physically suited to crops, some of them are used to a considerable extent for pasture and some even for forest.

The Fourth-class soils include those soils that are generally better suited physically to pasture than to crops, but a part of them are actually used for for crops and a part for forest. The Fifth-class soils support mainly forest, as they include steep, broken, or stony land on mountains, steep slopes, and ridges.

The fundamental conditions that influence the capacity of soils for different uses include the various internal characteristics of the soil, such as depth, texture, consistency, permeability, fertility, and water-holding capacity, and external characteristics like slope and stoniness. Many of these conditions are dependent to a considerable extent on the character of the parent rock. The parent material or substratum of the soils of the uplands is derived directly from the underlying rock, and in Russell County the rocks range from rather high grade limestone to noncalcareous sandstone. Between these extremes are interbedded limestone and shale, dolomitic limestone, cherty limestone, and noncalcareous shale. The various rock formations have contributed the material from which the overlying soils have formed, and the capability of the soils for the growing of plants and for continued use is determined to some extent by the character of the rock. In general, those rocks containing the greatest amount of calcium carbonate, such as the purer limestones, are overlain by the stronger soils; and those rocks having the greatest content of silica, such as siliceous sandstone, are overlain by soils that rank low in the production of crops. The other rock formations give rise to soils that range in productivity between the stronger soils over limestone and the poorer soils resting on siliceous sandstone. The
parent material of the soils developed from alluvial and colluvial formations was transferred from its original position above limestone, sandstone, or other rocks and in a new place gave rise to soils of different productivity, depending to some extent on the character of the original rock.

Although a soil may possess excellent internal qualities, the character of the slope on which it is formed determines to a large extent the use to be made of the land. Many slopes are so steep as to prevent the use of the land for cultivated crops.

Stoniness is another modifying condition that determines in large measure the use of land. Loose stones may be present on and in the soil in such small numbers as not to interfere with cultivation; in other places they may be so numerous as to render the land much less desirable for cultivation or even unfit for cultivation. In many places stone is present as small outcroppings of bedrock. The outcrops may be so numerous in some areas that they prevent the use of the land for growing cultivated crops.

Inadequate drainage affects only a small part of the soils of this county. The poorly drained areas are developed in flats and slight depressions near some streams. Poor drainage as a limiting condition in the use of soil is considered in the arrangement of the grouping of soils in classes.

FIRST-CLASS SOILS

Included as First-class soils are Hagerstown silt loam; Hagerstown silt loam, rolling phase; Pisgah silt loam; Pisgah silt loam, rolling phase; Decatur silty clay loam; Dunmore silt loam; Tumbez silty clay loam, rolling phase; Hayter loam; Emory silt loam; Emory silt loam, slope phase; Burgin silty clay loam; Burgin silty clay loam, slope phase; and Huntington silt loam.

The total area of these soils is about 14.6 square miles, or only slightly more than 3 percent of the area of the county. The soils are in the lowland (nonmountainous) belt, although much of their area is on the uplands. In general, they occupy the lowest uplands underlain by limestone. The relief ranges from nearly level and undulating to moderately sloping and rolling. These soils were among the first to be farmed. Many of them have been farmed almost continuously since the days of the pioneers, and those soils that have been carefully managed have deteriorated very little.

These soils are used extensively for the production of corn, wheat, and hay. Some areas are planted to tobacco, and some are used as pasture land.

The soils of the Hagerstown series are characterized by brown, reddish-brown, or brownish-red somewhat heavy surface soils and reddish-brown or brownish-red friable silty clay or clay subsoils. The soils work to a good tilth, and the surface soils in many places contain a moderate quantity of organic matter.

The surface soils of the Pisgah soils consist of brown friable silt loam or fairly heavy silt loam. They overlie subsoils of yellowish-brown friable silty clay loam. Apparently the surface soils contain fairly large quantities of humus, well mixed with the soil. Many small black mineral concretions are present in the subsoils and in the underlying layers.
Soils of the Decatur series have brown, dark-brown, or dark reddish-brown rather heavy textured surface soils and dark reddish-brown, deep-red, or maroon friable heavy silty clay or clay subsoils. Small black mineral particles are present in the subsoil and underlying soil material.

The soils of the Dunmore series have light-brown silt loam surface soils and brownish-yellow tough slightly plastic smooth silty clay subsoils, which on a cut surface take a high polish. The surface soils of these soils are comparatively thin and contain less organic matter than do the surface soils of the Pisgah soils.

The soils of the Tumbez series have gray or dark-gray heavy-textured somewhat plastic surface soils underlain by gray or dark-gray plastic silty clay subsoils containing small fragments of nearly white soft decomposing limestone. This material passes into limestone at a depth of about 15 to 24 inches. The soils are calcareous throughout.

The soils of the Hayter series have brown or dark-brown mellow loam surface soils that appear to contain a fairly large quantity of fine organic matter (humus). The subsoils are light-brown, brown, or faintly purplish brown friable slightly plastic silty clay loam. The soils are developed from colluvial material consisting of sandstone and shale fragments and finer soil material deposited at the base of mountains and on valley uplands.

The Emory series includes soils having light-brown, brown, or dark-brown mellow silt loam or heavy silt loam surface soils and light-brown or slightly reddish brown friable crumbly silty clay loam subsoils. The surface soils are comparatively thick and apparently contain fair quantities of organic matter. These soils have developed near the base of slopes and in depressions from fine soil materials washed from soils underlain mainly by limestone.

The soils of the Burgin series have very dark brown or almost black heavy plastic silty clay loam surface soils. The subsoils consist of mingled or mottled brown, ochreous-yellow, and light-gray heavy plastic silty clay. The surface soils probably contain a considerable quantity of organic matter. The soils have developed at the base of slopes, in limestone sinks, and near drainageways. The soil material consists of fine soil particles washed from soils on nearby slopes underlain by limestone.

Soils of the Huntington series have developed in first bottoms near streams from material that has been washed from slopes on uplands underlain by limestone and has been deposited near streams by running water. The soil consists of a brown or dark-brown mellow silt loam layer to a depth of about 18 inches, where it gives way to light-brown friable silty clay loam.

**Hagerstown silt loam.—**The 6-inch surface layer of Hagerstown silt loam is brown mellow rather heavy silt loam. It passes into faintly yellowish brown or light-brown friable silty clay loam, which continues to a depth of about 10 inches. The surface layer apparently contains a moderate quantity of fine organic matter, which is well incorporated with the mineral soil. The surface soil is dark brown when wet. The upper part of the subsoil is slightly reddish brown friable silty clay loam, and at a depth of about 34 inches it grades into reddish-brown or brownish-red somewhat heavier textured but friable silty clay. At a depth of about 42 inches the subsoil grades
into brownish-red friable silty clay loam soil material containing small spots and narrow streaks of ochreous yellow in many places. Limestone bedrock lies from 48 to 72 inches or more below the surface. A few small black mineral particles are distributed in the upper part of the subsoil, and these particles increase in number and size as the depth of the soil increases.

Hagerstown silt loam has developed from the residual products of soft highly calcareous limestone. It occupies some of the lowest positions on the uplands. The largest areas are in the south-central part of the county near Big Cedar Mill; others are near Honaker and near Elk Garden School. The bodies aggregate only 192 acres.

This soil has an undulating to gently rolling relief, the slope ranging from about 3 to 8 percent. Because of the gentle slopes, practically all of this soil can be used for the production of cultivated crops. Runoff of rain water is slow, and internal drainage is good. Erosion is active on small areas and has removed some of the surface soil. Small outcrops of limestone bedrock are present in a few places.

Almost all of this soil is cleared and farmed (pl. 8). Black walnut, black locust, redcedar, and a few oaks grow on a few small areas. A small part of the soil is in pasture, and the pasture plants consist chiefly of bluegrass, timothy, and orchard grass. Other vegetation growing in pastures includes crabgrass, foxtail, ragweed, broom-sedge, and dewberries. The soil is well suited to pasture.

Most of this soil is used for the production of corn, wheat, and hay. Tobacco is grown on small areas on some farms. Oats and barley are grown to a small extent. Under good management corn produces from 45 to 60 bushels an acre, wheat about 18 bushels, and tobacco 2,100 pounds. When the land is heavily manured, hay crops yield about 2 tons an acre in normal seasons. Oats and barley produce about 40 bushels on land fertilized with 200 pounds or 20 percent superphosphate. Oats grown on unfertilized land return about 25 bushels. Along Cedar Creek near Lebanon the normal annual yields obtained over a period of 20 years are as follows: Corn, 60 to 65 bushels an acre; wheat 18 to 20 bushels; and tobacco, about 2,200 pounds.

**Hagerstown silt loam, rolling phase.**—The rolling phase of Hagerstown silt loam differs from the typical soil mainly in the more rolling character of the land it occupies. It occurs in areas that are predominantly rolling, and the slopes range from about 8 to 15 percent. The surface soil and the subsoil are about the same in color, structure, and thickness as those of typical Hagerstown silt loam. The soil is recognized as distinct from typical Hagerstown silt loam, because it is less favorable for cultivation and because crops on it can be managed less easily than on the more gently sloping soil.

Included with this soil as mapped are areas of Hagerstown silty clay loam, rolling phase. The included soil consists of small areas of Hagerstown silt loam, rolling phase, from which about 50 percent of the surface soil has been removed by erosion. The remaining surface layer consists of yellowish-red or brownish-red heavy silty clay loam, 2 or 3 inches thick. These eroded areas are indicated on the soil map by symbols.

Hagerstown silt loam, rolling phase, occurs in many areas throughout the county and has a total area of about 5.9 square miles, of
which probably 0.1 of a square mile is the included Hagerstown silty clay loam, rolling phase.

Because of the moderate slope, the soil can be used almost everywhere for the growing of cultivated crops. With the exception of small outcrops of limestone bedrock here and there, the soil is free of stones. The runoff of surface water is rapid, and internal drainage is good. The soil is subject to considerable erosion unless protected by cover crops and by correct plowing.

A large part of this soil is used for cultivated crops. Some areas afford good pasture land. A few small areas are forested with black walnut, black locust, redcedar, and a few oak trees.

The crops grown, the fertilizer treatment given the land, and the crop rotation practiced are the same as for Hagerstown silt loam, and crop yields are slightly lower.

**Pisgah silt loam.**—The 8-inch surface soil of Pisgah silt loam consists of brown friable silt loam or heavy silt loam. A fairly large quantity of humus is well incorporated with the mineral soil. The subsoil is yellowish-brown friable silty clay loam that can be easily crushed to a structureless mass. Many small black mineral concretions and a few light-gray angular chert fragments ranging from about \(\frac{1}{8}\) to 1 inch in diameter are present in the subsoil. The subsoil continues to a depth of 35 to 38 inches, where it passes into light yellowish-brown friable crumbly silty clay loam material, which in places has a dark reddish-brown coating on the breakage planes. This material is slightly lighter in color and somewhat more friable than the clay in the subsoil. Small brownish-yellow and almost white fragments of chert are mixed with the material, and some of the fragments that are well weathered crumble readily into a white chalky substance. This material contains many small dark-brown and black mineral particles, and in places the breakage planes have a black film of mineral matter. Limestone lies at a depth of 48 to 72 inches or, in some places, considerably deeper. In some places the subsoil has a red cast, owing to a dark-red coating on the surface of the soil particles.

Pisgah silt loam has developed from the residual products of limestone high in calcium carbonate. Many fragments of chert are embedded in the limestone in places, and, when the limestone dissolves, these fragments remain as a part of the soil.

Like Hagerstown silt loam, this soil occupies some of the lowest positions on the uplands. Only 64 acres are mapped, mainly in the eastern part of the county east of Elk Garden School and near Rockdell and in the southwestern part southwest of Buckeye School.

The land is undulating and gently rolling, the slope ranging from 3 to 8 percent. The land is practically free of rock outcrops, and, because of the gentle slope, improved machinery can be used nearly everywhere on it. The soil is not nearly so erodible as Hagerstown silt loam, and the effects of erosion are most noticeable on sharp breaks near limestone sinks. It has good tilth and is fairly easy to work. The runoff is slow, and drainage through the soil is good. The soil is slightly acid in reaction.

Practically all of Pisgah silt loam is used for cultivated crops. A few black locust and black walnut trees grow here and there. A small part of the soil is in pasture. The soil makes excellent pasture
Good agricultural district in a limestone valley: Hagerstown silt loam in the foreground and Westmoreland silt loam on the steep slopes in the background.
A. Profile of Frederick cherty silt loam. Note the numerous fragments of chert, characteristic of this soil.  
B. Harvesting burley tobacco on Greendale silt loam.
land, and 1½ to 2 acres produce pasturage for a 1,000-pound steer. Pasture plants are mainly bluegrass and white clover. Other vegetation appearing in pastures includes foxtail, fleabane, broad and narrow-leaved plantain, broomsedge, dandelion, and yarrow.

Corn, wheat, and hay are the principal crops produced on this soil. Tobacco is grown in small patches on some farms. Under good management the following acre yields may be expected: Corn, 60 to 75 bushels; wheat, 15 to 25 bushels; tobacco, about 2,000 pounds; and Mammoth red clover (sapling clover), 2 to 3 tons of good quality hay in favorable seasons. Timothy and clover mixed produce 2 to 2½ tons of hay. The yields of all these crops are somewhat less on small areas in fields in which the soil is not so deep as the typical soil.

The better farmers practice a 4-year crop rotation, as follows: First year, corn or tobacco; second year, wheat or other small grain; third year, a hay crop; and fourth year, a hay crop or grass for pasture; or a 3-year rotation of cultivated crops, small grains, and clover.

**Pisgah silt loam, rolling phase.**—In color, texture, and structure of the surface soil and subsoil, Pisgah silt loam, rolling phase, is similar to Pisgah silt loam. In some places the surface soil and the subsoil are not so thick as in the typical soil, but in most places the physical characteristics are practically the same. Because of the somewhat steeper slope (6 to 15 percent), this soil is not so good as the typical soil for cultivation.

The total area of Pisgah silt loam, rolling phase, is 512 acres. The largest bodies are in the southern part of the county, near Hansonville; and several small areas are in the southwestern part near Buckeye School and in the southeastern part near Elk Garden and Rockdell.

This soil is used almost entirely for the production of cultivated crops. It is fairly easy to till and is slightly acid in reaction.

The crops grown, the crop rotations practiced, and the fertilizer treatment given the soil are the same as for Pisgah silt loam, and crop yields are nearly as good. A small part of the soil is used as pasture land, and it supports good pasture grasses. A few black locust and black walnut trees grow in places.

**Decatur silty clay loam.**—The surface soil of Decatur silty clay loam is dark-brown or reddish-brown fairly friable silty clay loam, about 8 inches thick. Apparently it has a fair content of well-decomposed organic matter. The subsoil consists of dark-red or maroon heavy firm silty clay, which continues to a depth of 36 to 60 inches, where it grades into red heavy plastic and sticky silty clay material mottled or streaked with light gray and ocherous yellow. In some places the surface soil has been thinned considerably by erosion, and in these places it is brownish-red heavy silty clay loam.

This soil is derived from the residual products of a limestone that is fairly high in calcium carbonate. Limestone bedrock lies at a depth of 5 to 15 feet or, in some places, considerably deeper.

Only 192 acres of this soil is mapped, mainly in the western part of the county near Castlewood. The surface ranges from undulating and gently rolling to rolling, and the slope ranges from 3 to 15 percent. The runoff is slow on the moderate slopes, but it is rather rapid in some of the steeper slopes and in places has washed off some of the
surface layer. Internal drainage is good. In places the soil is difficult to till on account of its sticky condition. Because of these areas of sticky soil, which does not scour readily from the plow, the soil is called "push land."

Nearly all of the land is used for the growing of cultivated crops, and a small part is used as pasture. Corn, wheat, and hay are the main crops grown. The fertilizer treatment for the soil and the crop rotations practiced are the same as for Hagerstown silt loam, but the yields are slightly lower in some places than on that soil. The Decatur soil affords good pasturage.

**Dunmore silt loam.**—The surface layer of this soil is brown or light-brown heavy smooth silt loam that, when dry, is light grayish brown or very light brown. The surface layer is about 6 inches thick and is underlain by a 2-inch subsurface layer of yellowish-brown or mingled light yellow-brown and dark reddish-brown friable silty clay loam. The subsoil is brownish-yellow, yellowish-brown, or slightly reddish brown tough moderately plastic smooth silty clay that presents a glistening appearance on a cut surface. In places small spots of ochrous yellow appear in this material. At a depth of 22 to 35 inches the subsoil grades into dark reddish-brown friable slightly plastic silty clay loam containing small spots or streaks of ochrous yellow and very light gray. This material rests on limestone at a depth of 45 to 72 or more inches. In places a few particles of light-colored chert are on the surface and in the subsoil.

The material from which this soil is developed is underlain by gray dolomite or dolomitic limestone, in some of which appear narrow beds of quartz sandstone. Chert is present in the rock in varying proportions.

Although the total area is not large (1,408 acres), small areas are distributed rather widely through the county.

A small part of the land is undulating; the rest is moderately sloping or rolling. The slope ranges from 3 to 15 percent. The land nearly everywhere is favorable to the use of improved machinery. Limestone sinks have formed here and there, and a few outcrops of limestone are present. Practically all of the intermittent drainage ways can be crossed with heavy farm machinery. Both surface and internal drainage are good. A small quantity of the surface soil has washed away in places, and shallow gullies have formed in a few places. The supply of organic matter in the soil is medium to low.

The soil is used mostly for cultivated crops and pasture. On the few areas in forest the tree growth consists of white oak, black oak, scarlet oak, tuliptree, black walnut, black locust, dogwood, maple, and red oak. Formerly chestnut trees grew in places, but today they are either dead or have been severely injured by blight.

A small part of the land is in pasture, and bluegrass and crabgrass are the main grazing plants. Broomsedge and briers are common in some places. Various weeds and wild grasses grow in some of the pastures. About 3 to 4 acres of pasture is required to support one 1,000-pound steer.

The field crops are principally corn, wheat, and hay, and these are grown in a 4-year rotation, consisting of corn, wheat, timothy and clover, or clover for use as hay and pasture. Tobacco is grown in small fields on some farms.
Under good management corn yields from 40 to 50 bushels an acre and is usually fertilized with 200 pounds of 4-12-4 fertilizer, 150 pounds of 0-12-4 fertilizer, or 20 percent superphosphate, depending on the quantity of manure or organic matter returned to the soil. In some places the higher yields are on land that has been limed as well as fertilized. On well managed land that has received an application of stable manure and 200 pounds of 4-12-4 fertilizer, corn may be expected to yield about 50 bushels an acre. Corn produces 35 to 40 bushels on land not fertilized. In some fields the higher yields are obtained where the land was subsoiled. Under favorable conditions wheat yields 14 or 15 bushels an acre on land treated with 200 pounds of 4-12-4 fertilizer or 20 percent superphosphate, and about 20 bushels on land treated with lime in addition to the fertilizer. Tobacco yields range from 1,200 to 1,500 pounds an acre, and hay crops yield about 1 to 2 tons of hay. Oats are grown on some farms and yield about 20 to 25 bushels. Beans and cabbage are grown in a small way and make good yields. Sweetpotatoes and potatoes are grown by a few farmers. Yields of potatoes are good, but those of sweetpotatoes are comparatively low. Land for potatoes is fertilized by some farmers with 150 to 200 pounds an acre of 5-7-5 or 4-12-4 fertilizer.

Tumbez silty clay loam, rolling phase.—The rolling phase of Tumbez silty clay loam occupies somewhat gentle relief, the slope ranging from about 8 to 15 percent. It is similar in color, texture, and structure to Carbo silty clay loam, but in some places the soil layers are slightly thicker. Because of the gentler slope, the soil is more advantageous for the cultivation of crops than Carbo silty clay loam, which occupies much steeper slopes.

Only 64 acres of this soil is mapped, mainly in the eastern part of the county near Repass, in the central part south of Spring City, in the southern part southeast of Mount Olive Church and north of Jessie School, and in the southwestern part west of Dickensonville.

A few small areas are undulating or gently rolling, and the rest of the land is rolling. Runoff is rather rapid, but internal drainage is slow. Erosion has reduced the thickness of the surface soil in a few places.

Practically all of the land is planted to corn, hay, and grass. Some areas are planted to alfalfa and to clover for hay. Crop yields and fertilizer treatment are about the same as for these crops grown on typical Tumbez silty clay loam. A few black walnut, oak, redecessar, black locust, and black gum trees grow in places.

Hayter loam.—The surface soil of Hayter loam is brown or dark-brown mellow loam containing a fairly large quantity of organic matter. When dry, the soil is light brown and in places has a purple hue. The subsoil, beginning at a depth of 10 to 15 inches, consists of light-brown, brown, or faintly purplish brown friable slightly plastic silty clay loam or silty clay. A few black mineral specks are present in this layer. At a depth of 28 to 32 inches the subsoil grades into light-brown friable silty clay loam containing purple and ochersous-yellow soft decayed shale particles and a few black mineral particles. In some places soft decomposed brown stone fragments are present in the soil material. A few brown angular sandstones, 2 to 4 inches in diameter, are scattered over the surface, and some are embedded in the soil.
The soil is underlain by fragments of brown sandstone that have rolled from nearby mountain slopes and collected in beds on the valley floors. Material from purple soils and from brown soils overlying limestone is mixed with the sandstone fragments. Hayter loam has developed from this material of mixed origin. The land ranges from nearly level to gently rolling or rolling, having a slope of 2 to 15 percent.

Only 1.4 square miles of this soil is mapped. The largest areas are in the eastern part of the county.

Because of the comparatively smooth surface, most of this soil can be used for cultivated crops. Surface drainage and internal drainage are good. The effect of erosion on the soil is slight. The reaction is medium acid.

Corn, wheat, and hay are the principal crops, and tobacco and oats are grown less extensively. Potatoes are grown on small areas. The better practice on the soil seems to be the growing of crops in a rotation that includes corn or tobacco, followed by wheat or rye, and either of these followed by a hay crop.

Corn yields 40 bushels an acre without the aid of fertilizer, if a good rotation system is followed. It will yield 50 to 60 bushels, and wheat 12 to 15 bushels, on land treated with 200 pounds of 4-12-4 fertilizer or 20 percent superphosphate in a similar rotation. Tobacco yields from 1,400 to 2,000 pounds, oats about 20 bushels, alfalfa about 2 tons of hay annually, in two or three cuttings, and clover from 1 to 1½ tons of hay. Potatoes yield well.

**Emory silt loam.**—The 10- to 18-inch surface soil of Emory silt loam consists of brown, light-brown, or dark-brown mellow silt loam or heavy silt loam. The subsoil is light-brown or slightly reddish brown friable crumbly silty clay loam containing a few black mineral particles. At a depth of 30 to 35 inches the subsoil grades into friable silty clay loam soil material carrying a rather large number of black mineral particles that are larger and more numerous in the lower part. The surface soil apparently contains a comparatively large quantity of fine organic matter, which is thoroughly incorporated with the soil. When the soil is wet, the color of the surface soil is darker than when the soil is moist.

Emory silt loam is derived mainly from rainwash material that has been deposited near the bases of slopes, in depressions, and near intermittent drainageways. This material was washed principally from areas of Hagerstown, Dunmore, and Frederick soils.

This soil occupies 882 acres, rather widely distributed over the county.

The land is almost level or undulating, and the slope ranges from 2 to 8 percent. Because of the favorable surface features, this soil in most places can be used for cultivated crops. Surface and internal drainage are good. The land is so smooth that erosion has affected the soil very little. According to field tests, the soil is medium acid or slightly acid in reaction.

This soil ranks high in productivity, and most of it is used for field crops, chiefly corn, wheat, and hay. On some farms, tobacco is grown on small areas. A small part of the soil is used only for pasture. Home gardens are planted on this soil on some farms, and potatoes are planted on small areas.
Under good management, corn yields from 55 to 75 bushels an acre; wheat, 20 to 25 bushels; and hay crops, 1 1/4 tons of hay at each cutting, and two cuttings are made in a season. Tobacco yields 1,800 to 2,300 pounds. Rotation of crops is practiced by some farmers on this soil, and the principal rotation consists of corn or tobacco, wheat, and the third year timothy and clover for hay. The land is pastured the fourth year on practically all of the farms using this rotation.

**Emory silt loam, slope phase.**—The slope phase of Emory silt loam is similar to the typical soil in color, texture, and structure of the surface soil and subsoil. The slopes, however, are more pronounced than those of typical Emory silt loam. They range from about 8 to 15 percent or slightly more in places.

This soil occurs in the northern part of the county about 1 mile northeast of Artip and in the central part east of Munseys Chapel, northeast of Glade View Church, and northeast and southwest of Dickensonville. The aggregate area is only 64 acres.

This soil occupies moderate slopes, and most of it lies well for cultivated crops. Drainage in the surface soil and in the subsoil is good. The soil is medium acid to slightly acid in reaction. Its productivity is about equal to that of typical Emory silt loam, and it is separated from that soil on the map mainly because of its steeper slopes.

Corn, wheat, and hay are the principal crops grown. The fertilizer applied, crop rotation practiced, and crop yields obtained are about the same as those for Emory silt loam.

**Burgin silty clay loam.**—The 10- to 12-inch surface soil of Burgin silty clay loam is very dark brown or almost black heavy plastic silty clay loam that apparently contains a comparatively large quantity of humus. When dry the soil is light gray and breaks readily into angular lumps 2 or 3 inches in diameter. When the soil is dry the surface of the land presents a network of cracks. The subsoil to a depth of about 35 inches is finely mingled brown, ocheron-yellow, and very light gray heavy tough plastic silty clay. On drying, this material cracks and breaks into angular soil fragments ranging from 1/4 to 1 inch in diameter. The breakage planes of these fragments are coated dark brown. Many small black mineral particles are present in the subsoil. In some places the subsoil is brown and contains a few small spots of ocheron yellow; in a few places it is slightly purplish brown. In many places the subsoil is only moderately plastic. The surface soil has a purple cast in some places.

This soil occurs in limestone sinks and depressions and a few small areas near streams. The material from which most of the soil has formed was washed from nearby slopes underlain by limestone. The soil varies somewhat in color, depending on the color of the soil from which the original material was washed.

The areas occurring near streams are near Hansonville. Soil material washed from nearby slopes, occupied mainly by Carbo silty clay loam, Westmoreland silty clay loam, or Bland silty clay loam, gives rise to most of this soil.

The total area of Burgin silty clay loam is 882 acres. In addition to the areas mentioned in the foregoing paragraph, a fair-sized area
borders Dry Branch northeast of Elk Garden. Smaller bodies are scattered over the county.

The land is nearly level to undulating. Surface drainage is fair, but internal drainage is slow. The organic-matter content ranges from medium to high, and in most places the soil needs no lime. This soil sustains crops very well during a dry season. Because of its heavy texture, the soil is more difficult to cultivate than Emory silt loam.

All the land is cleared of forest and is in agricultural use. Most of it is planted to corn continuously or in a 4-year rotation to corn, wheat, hay, and grass. Some areas are devoted to tobacco, and a few are in pasture. Corn yields from 50 to 75 bushels an acre under good management without fertilizer. Wheat returns slightly lower yields than those obtained on Huntington silt loam. Tobacco yields 2,000 pounds an acre on land that has been fertilized. Hay crops give good returns.

Pastures are good. The pasture plants include bluegrass, white clover, and crabgrass. Ragweed, aster, and wild carrot grow in some places.

Burgin silty clay loam, slope phase.—The characteristics of the surface soil and subsoil of this soil are similar to those of typical Burgin silty clay loam. The main difference between the two soils is in relief. This soil occupies areas having an 8- to 15-percent slope, whereas the typical soil occupies areas having a very slight to nearly 8-percent slope.

This soil occupies only 128 acres, mainly in the central part of the county west of Lebanon and in the southwestern part southwest of Dickensonville.

The surface soil is well drained, but internal drainage is somewhat retarded by the dense clay subsoil. The organic-matter content is medium to comparatively high. Because of the rather heavy texture of the surface soil, the soil is not so easily cultivated as the more friable soils. Crops make good yields, even in a dry season. In most places the soil does not need lime. The crops grown and the kind of fertilizers applied are the same as for Burgin silty clay loam, and the yields obtained are practically the same as those obtained on that soil.

Huntington silt loam.—To a depth of about 18 inches Huntington silt loam is brown or dark-brown mellow silt loam or heavy silt loam. Beneath this layer the soil is brown, light-brown, or light-brown and brown mixed friable silty clay loam containing a few black mineral particles. At a depth of 30 to 35 inches this layer grades into light-brown or brown friable sticky fine sandy clay material that, like the material above, contains a few black mineral particles and, in places, small brownish-yellow concretions, probably composed of lime.

Huntington silt loam occupies narrow strips in the first bottoms of some streams in the eastern, central, and southwestern parts of the county. This soil is developed from alluvial material consisting of fine soil particles washed from soils on the uplands underlain by limestone. In places small quantities of material of sandstone and shale origin are present in the alluvial material.

The total area of this soil is 384 acres. The principal bodies border Indian Creek, northeast of Belfast Mills Church; Cedar Creek and
Dry Branch, northeast of Elk Garden; and Moccasin Creek, especially near Collinwood.

Huntington silt loam is nearly level to gently undulating and lies well for the cultivation of crops. Both the surface soil and the subsoil are well drained.

Probably 65 percent of the soil is used for field crops, and the rest is devoted to pasture. Corn, wheat, and hay are the principal crops; oats, barley, and tobacco are minor crops. Corn yields 60 to 75 bushels an acre, wheat 15 to 20 bushels, oats 30 to 35 bushels, clover about 2 tons of hay, and alfalfa 2 to 4½ tons of hay in three cuttings. Fertilizer is not applied for these crops except for wheat. Corn, wheat, and hay are grown by some farmers in a 4-year rotation of (1) corn, (2) wheat, and (3) clover or some other hay crop for 2 years. Under good management tobacco produces 1,900 pounds an acre.

One of the largest areas of this soil is in pasture, and the soil supports an excellent stand of grass throughout the grazing season. Two acres of the soil will supply grazing for one 3-year-old steer. Bluegrass and crabgrass are the main pasture grasses. Other plants in the pastures are white clover, broad- and narrow-leaved plantain, and broomsedge.

SECOND-CLASS SOILS

Second-class soils include Hagerstown silt loam, hilly phase; Pisgah silt loam, hilly phase; Decatur silt loam, hilly phase; Dunmore silt loam, hilly phase; Frederick silt loam; Frederick silt loam, hilly phase; Frederick cherty silt loam; Lodi loam; Elliber silt loam; Elliber silt loam, hilly phase; Elliber cherty silt loam; Bolton loam, rolling phase; Bland silt loam, rolling phase; Carbo silt loam, rolling phase; Tumbez silt loam; Hayter loam, hill phase; Greendale silt loam; Greendale silt loam, slope phase; Sequatchie loam; Sequatchie loam, slope phase; Lindside silt loam; Pope fine sandy loam; and Pope silt loam.

The aggregate area of these soils is approximately 33.7 square miles, or 7 percent of the total area of the county. They occur mainly in the low nonmountainous belt, although uplands comprise much of this area. The soils of the uplands are underlain mostly by limestone, consisting of rather high grade limestone, dolomitic limestone, or cherty limestone. Some of the limestone beds contain thin strata of sandstone, and some areas are underlain by limestone and shale in alternate layers. Some of the soils have developed near streams from alluvial materials consisting of fine soil particles derived from soils on the slopes of the uplands underlain by limestone or by sandstone and shale.

The relief of the soils occurring on the uplands is rolling, strongly rolling, hilly, and in some places steep; and the relief of the soils occurring at the foot of slopes and in bottoms near streams is nearly level, undulating, or moderately sloping. Drainage is well established in all the soils, except in the subsoil and underlying layers of some of the soils developed in first bottoms.

These soils are grouped as Second-class rather than First-class soils because they have one or more characteristics that make them less suitable for cultivation. Among these characteristics are steeper
slopes, the presence of chert, lower fertility, shallower or less pervious soil layers, or less favorable moisture conditions. Many of these differences are due to the character of the parent material. Some of the soils that have a steeper slope than the First-class soils have a hilly relief, in places steep, causing the soils to be less desirable for cultivation than the soils having a gentler relief. Although some of the soils occupy a position that is more favorable for cultivation than that of some of the First-class soils, they are grouped separately because of the presence of chert fragments, the leached condition, or because the parent material is not of such composition as to produce such strong soils as the First-class soils.

Hagerstown silt loam, hilly phase; Pisgah silt loam, hilly phase; Decatur silty clay loam, hilly phase; and Dunmore silt loam, hilly phase, occupy much steeper slopes than the Hagerstown, Pisgah, Decatur, and Dunmore soils of the First-class soils, and because of their steepness they are less suitable for cultivation than the soils that occupy gentler slopes.

Members of the Frederick series are characterized by light-brown or grayish-brown silt loam surface soils and light-red or yellowish-red friable brittle silty clay subsoils. Frederick cherty silt loam has many small angular chert fragments on the surface, in the surface soil, and, in many places, in the subsoil. The surface soil is comparatively thick and apparently has been considerably leached. The soils of the Lodi series are derived largely from residuum from the weathering of interbedded limestone and sandstone. The surface soil is comparatively thick and is apparently much more leached than the surface soil of soils of the Hagerstown, Pisgah, and Decatur series. Sandstone has contributed fine sand particles to the soil. The subsoil is friable and fairly retentive of moisture. This soil does not respond to methods of improvement so readily or retain lime or fertilizer so long as do the stronger Hagerstown, Pisgah, and Decatur soils.

Members of the Elliber series have a light-brown or grayish-brown smooth silt loam surface layer, which passes into light-yellow or brownish-yellow heavy silt loam at a depth of about 8 inches. The subsoil, beginning at a depth of about 18 inches, is yellowish-brown friable silty clay that becomes hard and brittle on drying. Elliber cherty silt loam is characterized by a large quantity of chert fragments on the surface and in the surface soil. Chert fragments are also present in varying quantities in the subsoil and throughout the soil material. Soils of the Bolton series overlie sandstone, which is present in limestone formations and which on weathering contributes material to the formation of these soils. Iron ore, probably limonite, which is present as scattered fragments in places, possibly imparts coloring matter to the soil material. The surface soil of Bolton loam, rolling phase, is brown mellow loam, and the subsoil is yellowish-brown or reddish-brown friable heavy loam or fine sandy clay. This soil is darker and less leached in the surface soil than soils of the Lodi series, although the origin of the soils of both series is similar.

The soils of the Bland series have purplish-brown surface soils and purplish-brown or purplish-red subsoils. The soil is developed mainly from the weathered products of interbedded purplish-red and gray limestone. The surface soils of the Carbo soils are slightly
grayish brown silty clay loam; the subsoils are yellowish-brown rather
plastic silty clay and in many places are reddish brown in the lower
part. The soils of this series are developed over limestone contain-
ing, in places, thin strata of shale or clayey material. Tumbez silty
clay loam and Hayter loam, hill phase, occupy steeper slopes than
the Tumbez and Hayter soils of the First class. The soils of the
Greendale series have comparatively thick grayish-brown or grayish-
yellow friable silt loam surface soils. The subsoils are brownish-
yellow or yellow friable silty clay loam. These soils have developed
at the base of slopes, near intermittent drains, and in depressions from
soil material washed from nearby slopes underlain by calcareous
shale, shale and limestone mixed, or limestone. The surface soils
are considerably leached and are comparatively low in organic matter.
The soils of the Sequatchie series have developed on low terraces
and high bottoms near streams from alluvial material derived from
slopes of the uplands underlain by sandstone and shale and some
limestone. The surface soils are brown mellow loam and probably
contain considerable humus. At a depth of about 15 inches the sur-
face soils pass into faintly yellowish brown friable slightly plastic
silty clay loam subsoils.

The Lindside soils occur in the first bottoms near streams, and
drainage in the lower part of the soil is not well established. The
material from which the soil is developed was deposited along the
streams by running water and originally was washed from slopes
underlain mostly by impure limestone. The surface soil of Lindside
silt loam is brown or light-brown friable silt loam, and the subsoil
is mingled light grayish-brown and dark-brown friable crumbly silty
clay loam. At a depth of about 30 inches the subsoil passes into
gray rather heavy and somewhat plastic silty clay loam or clay con-
taining small spots of brown. Members of the Pope series have
developed in first bottoms near streams from alluvial materials that
originally were derived from slopes of the uplands underlain mainly
by sandstone and shale. Drainage is fairly good in all parts of
these soils. The surface soils are light brown, brown, or dark brown,
and are friable. The subsoils are light-brown, yellowish-brown, or
brown friable fine sandy clay, sandy clay, or silty clay loam. At
a depth of about 32 inches the subsoils become more friable and in
places contain rounded sandstone gravel or angular fragments of
sandstone and shale.

A rather large area of the Second-class soils is planted to corn,
wheat, and hay crops. Some of the soils are used in the production
of tobacco. A fairly large part of the soils is used as pasture land.
In general, yields of crops on the Second-class soils are not so good
as those obtained on the First-class soils.

Hagerstown silt loam, hilly phase.—The hilly phase of Hagers-
town silt loam has slopes ranging from about 15 to 30 percent. The
soil characteristics are similar to those of typical Hagerstown silt
loam, except that in places the surface soil is thinner and in many
places the subsoil is shallower.

The aggregate area of this soil is about 7 square miles. It occurs
chiefly within a belt that roughly parallels the Clinch River. Several
areas are around Lebanon.
This soil erodes more readily than the typical soil, which occupies smoother areas, and greater precaution is necessary to prevent the surface soil from being washed away. Because the land is hilly, the soil is less suitable for the cultivation of crops than Hagerstown silt loam and Hagerstown silt loam, rolling phase.

A larger part of this soil than of the smoother Hagerstown soils is used as pasture land. The pasture grasses are mainly bluegrass and crabgrass and, in places, timothy and orchard grass. Other plants in some pastures are broomsedge, ragweed, foxtail, and dewberries. Small areas of the soil support a tree growth consisting of black locust, black walnut, redbud, and a few oaks.

The principal crops are corn, wheat, and hay. Under good management corn yields from 35 to 45 bushels an acre, wheat 15 bushels, and hay crops 1 to 1 1/2 tons of hay. Tobacco is planted in small fields on some farms. It yields about 1,800 pounds an acre when properly fertilized. A common 4-year rotation includes corn or tobacco, wheat, a hay crop, and grass for pasture. It would be better to extend the rotation by keeping the land in grass for 3 or 4 years. This longer rotation would conserve the surface soil more adequately on the steeper slopes than a rotation having a shorter period of grass cover.

Pisgah silt loam, hilly phase.—This hilly soil is similar to Pisgah silt loam, except that the relief is steeper and the surface soil is generally thinner. In some places on the steeper slopes the subsoil is shallower than in areas on the gentler slopes. The soil occupies slopes ranging from about 15 to 30 percent or more.

Owing to hillyness, areas of this soil are not so advantageous for cultivated crops as the smoother areas of Pisgah silt loam. It is used largely for field crops, but the yields are somewhat lower than for crops on the typical soil. Corn, wheat, hay, and grass are the principal crops. Tobacco is grown in small areas on some farms. The rotation of crops practiced and the fertilizers applied are the same as on Pisgah silt loam. Some of the soil furnishes good pasturage. The principal pasture plants are bluegrass, crabgrass, and white clover. Other plants growing in the pastures are foxtail, fleabane, broad and narrow-leaved plantain, broomsedge, dandelion, and yarrow.

A total area of only about one-half of a square mile is mapped, chiefly between a point northwest of Old Rosedale and a point northeast of Rosedale.

Decatur silty clay loam, hilly phase.—The hilly phase of Decatur silty clay loam is similar to the typical soil in color, texture, and structure of the surface soil and subsoil, and differs from it mainly in the character of its relief. This soil occupies hilly areas having slopes of 15 to 30 percent, whereas Decatur silty clay loam occupies rolling areas having slopes of 3 to 15 percent. Owing to the somewhat steeper slope, this hilly soil is less advantageous for cultivation and more subject to erosion than the typical soil.

Only 128 acres of this soil is mapped, chiefly in the western part of the county near Castlewood in association with typical Decatur silty clay loam.

This hilly soil is used for the growing of cultivated crops, and some areas are used as pasture land. The crops grown are mainly corn, wheat, and hay. Although the fertilizer treatment for the
crops is about the same as on Hagerstown silt loam, crop yields are somewhat lower. This hilly land is subject to rather severe erosion unless protected by cover crops.

**Dunmore silt loam, hilly phase.**—The hilly phase of Dunmore silt loam occupies slopes ranging from about 15 to 30 percent or more. The surface soil and the subsoil are similar in color, texture, and structure to those of typical Dunmore silt loam, but these layers are not everywhere so thick, because unfavorable relief has prevented the development of thick layers as in the typical soil. Because of its hilliness, this soil is not so desirable for cultivated crops as Dunmore silt loam.

This soil covers about 3.2 square miles. It occurs in many parts of the county. The largest areas are several miles northeast of Honaker, along the Clinch River northeast of Swords Creek, near Belfast Mills, near Elk Garden, and along the Scott-Washington County line.

This soil is well drained in both the surface soil and the subsoil. Surface waters move rather rapidly from the steeper slopes and in places have washed away part of the surface soil and in other places have formed shallow gullies. The soil has a medium to low organic-matter content. The reaction is strongly acid or very strongly acid. In order to correct the acidity, some farmers apply 4,000 to 5,000 pounds an acre of burnt lime to the land.

A large part of the soil is clear of forest and is used for the production of field crops. Corn, wheat, and hay are the leading crops. Corn may be expected to yield about 35 bushels an acre and wheat about 15 bushels on well managed land treated with 200 pounds of 4-12-4 fertilizer or 20 percent superphosphate. Hay crops yield about 1 ton of hay. Tobacco is planted on a few areas. Under good management it returns about 1,200 pounds an acre. Rye is grown by a few farmers and is cut for feed, yielding about half a ton to the acre. Some areas of the soil are devoted to pasture, and 3 to 4 acres will supply grazing for one 1,000-pound steer. Bluegrass and crabgrass are the important grazing plants. Broomedge, running briers, and various weeds grow in many pastures.

Because of the unfavorable slope and the hazard of erosion, the steepest areas of this soil are better suited to pasture than to cultivation.

A few small areas are in forest. The trees include white oak, black oak, scarlet oak, tuliptree, black walnut, black locust, dogwood, red maple, and red oak.

**Frederick silt loam.**—The 7- to 10-inch surface layer of Frederick silt loam is brown, light grayish-brown, or grayish-brown silt loam. This layer is underlain by a 3- or 4-inch subsurface layer of reddish-yellow or mingled dark reddish-brown and light yellowish-brown friable silty clay loam. The subsoil is light-red, slightly yellowish red, or brownish-red friable silty clay that in some places is rather heavy, hard, and brittle. At a depth of 35 to 38 inches the subsoil passes into slightly reddish brown friable silty clay loam that contains small spots of dark reddish brown and ocherous yellow and, in places, soft white chalklike decomposing chert. The soil material rests on limestone at a depth of 4 feet or more. A few small gray or light-yellow fragments of chert are on the surface in places.
Some pieces of chert are present in the surface soil and in the subsoil. Small spots and narrow streaks of reddish-yellow heavy silty clay loam here and there in some fields mark eroded places or places where the subsurface or subsoil material has been brought to the surface by the plow.

This soil covers a total area of about 1.2 square miles, occurring mainly in small scattered bodies in the central and southwestern parts of the county and in the south-central part near Mount Olive Church.

Frederick silt loam occupies undulating and gently rolling to rolling areas having a slope of 3 to 15 percent. Surface and internal drainage are good, although on the steeper slopes runoff of rain water is rather rapid. A few limestone sinks have formed, and bedrock outcrops in places. Because of the smooth surface, the land almost everywhere can be used for crops, although some of the drainage channels are difficult for heavy farm machinery to cross.

The greater part of the land is planted to corn, wheat, hay crops, and grass. Tobacco occupies a small total acreage. The better practice is a 3-year rotation of corn or tobacco, small grain, and clover. In such a rotation corn may be expected to yield 45 to 55 bushels an acre on well-fertilized land; wheat, 15 to 20 bushels; and tobacco, 1,000 to 1,200 pounds. Hay makes yields ranging from ¾ to 1½ tons an acre, but higher yields are obtained when the soil is fertilized and limed. Some areas are used for pasture, and 3 to 4 acres of the land affords pasturage for one 1,000-pound steer.

Frederick silt loam, hilly phase.—The hilly phase of Frederick silt loam resembles the typical soil, except that it is steeper and the surface soil in some places is shallower. The slope ranges from 15 to 30 percent. The land does not lie so well for the cultivation of crops as does typical Frederick silt loam.

The aggregate area of this soil is about 6.1 square miles. Most of the areas are in the central and southwestern parts of the county, especially between Copper Ridge and Moccasin Ridge.

This soil is well drained, both in the surface soil and in the subsoil. In unprotected places on the steeper slopes surface waters move off rapidly, and in some places they have carried away the surface soil material. Limestone bedrock outcrops here and there. Many of the drainage channels are difficult to cross with heavy farm machinery. The soil apparently contains comparatively little organic matter.

A large part of the soil is used for the growing of field crops, principally corn, wheat, hay, and grass. Tobacco is planted in small areas on some farms. Under good management corn produces from 30 bushels to 45 bushels an acre; wheat, 12 to 15 bushels; tobacco, about 1,000 pounds; and hay crops, three-fourths to 1 ton of hay. The soil supports fair pasture, and an area of 3 to 4 acres provides grazing for one 1,000-pound steer.

The better farming methods practiced on this soil consist of a 4-year rotation of corn or tobacco, wheat or other small grain, hay, and grass.

A few small tracts of the land are in forest, and the trees include different species of oaks, hickory, dogwood, black gum, sourwood, black locust, and black walnut.
Frederick cherty silt loam.—This soil has developed from the residual products of impure limestone, dolomitic limestone, and dolomite. Chert is present in large quantities in these rocks, and, when the rocks break down through weathering, the chert remains on the surface and in the soil as light-gray angular fragments, ranging from about \( \frac{1}{4} \) to 1 inch in diameter, although in some places the fragments are 5 or 6 inches in diameter. Strewn over the surface and mixed with the surface soil, these fragments compose about 15 to 35 percent of the soil mass. Many fragments are also present in the subsoil and in the underlying soil material in places. On weathering, some of these have broken down and added white powdery material to the soil.

The surface soil of Frederick cherty silt loam (pl. 4, A) is light grayish-brown, gray, or light-brown silt loam and at a depth of about 6 inches changes to yellowish-brown, brownish-yellow, or light-yellow friable silt loam or heavy silt loam, which continues to a depth of about 18 inches. In plowed fields the surface layer is light brown or light grayish yellow when dry. In some plowed fields, streaks and small spots of reddish yellow mark places where the surface soil is thin. In forested areas and in some pastures the first inch or so of the surface soil is brown or grayish brown because of the presence of organic matter derived from decayed leaves and twigs or grass. The subsoil is dark reddish-brown, brownish-red, or reddish-yellow friable somewhat plastic silty clay in most places, but it is yellowish-brown rather tough slightly plastic smooth silty clay in some places. At a depth of 32 to 35 inches the subsoil passes into mingled, mottled, or streaked dark reddish-brown, ochreous-yellow, and light-gray friable silty clay loam, which rests, at a depth of 50 or more inches, on limestone.

This soil has a total area of about 2 square miles. It is distributed in the eastern, central, and southeastern parts of the county.

The land is undulating and gently rolling to rolling, although the prevailing relief is rolling. The slopes range from 3 to 15 percent. Because of the rather large quantity of chert fragments present, the soil is fairly open, and because of the gentle slope it can be used in most places for cultivated crops, although some of the drainage channels make it difficult to use heavy farm machinery. Runoff of surface water is adequate, and internal drainage is good. The natural fertility of the soil is only fair, and in unimproved land the organic-matter content is comparatively low. Corn, wheat, and tobacco require fertilization of the land for best results. The reaction is strongly acid in both the surface soil and the subsoil.

Most of this soil is used for the production of corn, wheat, hay, and grass. Tobacco is grown on small areas, and oats are grown to some extent. The soil seems to be better adapted to small grain than to other crops.

Under good farm practices, corn produces from 35 to 50 bushels an acre on land that has been fertilized and manured, and it yields 25 to 35 bushels on unfertilized land in a good rotation. Wheat yields 10 to 18 bushels on land treated with the same kind and quantity of fertilizer as is used on cornland; tobacco, 1,000 to 1,800 pounds on fertilized land; and hay crops, \( \frac{3}{4} \) to 2 tons of hay.
A good cropping practice followed on this soil is a 3-year crop rotation as follows: First year, corn or tobacco; second year, wheat or other small grains; and third year, clover. In this rotation, stable manure and 20 percent superphosphate are applied for corn, and complete fertilizers are applied for small grains.

Some areas of the soil are in pasture, and 3 or 4 acres furnish grazing for one 1,000-pound steer. Pasture plants include bluegrass, crabgrass, meadow fescue, sheep fescue, and lespedeza. Other plants appearing in some of the pastures are broomsedge, foxtail, fleabane, aster, and dewberries, as well as the plants locally called hairy spurge and life everlasting.

A small part of the land is in forest, and the trees are mainly various species of oaks, black gum, hickory, sourwood, dogwood, black walnut, and black locust. Dead chestnut trees appear among the other trees in some places.

Lodi loam.—The surface layer of Lodi loam is brown or light-brown friable loam, which passes at a depth of 6 or 8 inches into a light-brown or mingled light yellowish- and reddish-brown friable very fine sandy clay subsurface layer, 3 or 4 inches thick. The subsoil is yellowish-brown or slightly reddish brown friable but somewhat hard silty clay loam containing an appreciable quantity of very fine sand. At a depth of 32 to 38 inches the subsoil is underlain by light-brown friable crumbly silty clay loam that is spotted or faintly streaked with ocherous yellow and has a dark reddish-brown mineral coating on the breakage planes. The texture of the surface soil varies from place to place and ranges from loam to fine sandy loam. In places, small quantities of small angular fragments of chert are present on the surface and in the soil. Fragments of brown sandstone, 3 to 5 inches in diameter, are scattered here and there on the surface, and a few of them are embedded in the soil. The soil material for the most part is derived from decomposed limestone containing strata or beds of sandstone at a depth of 4 feet or more, although in some places the sandstone is much nearer the surface. In general, the sandstone is present in thin to comparatively thick layers, and the weathering of this rock contributes sand to the soil mass. In some places Dunmore silt loam is covered with a layer of fine sandy material derived from the breaking down of sandstone fragments, which were deposited on the soil by colluvial action. Soil thus formed is almost identical with Lodi loam, and a few areas of such soil are included with Lodi loam in mapping. In agricultural use this included soil is the same as typical Lodi loam.

The total area of Lodi loam is 512 acres. The largest bodies are in the northern, northeastern, eastern, and southwestern parts of the county.

This land ranges from undulating to rolling, and the slope ranges from 3 to 15 percent, but most of it is rolling. Surface drainage channels are short and numerous, and springs are plentiful. The drainageways can be crossed with heavy farm machinery in most places. Small outcrops of bedrock are present here and there. Erosion is active on some of the slopes, and in places it has carried away a part of the surface soil. Shallow gullies have formed in some places. The organic matter content apparently is low. The soil is medium acid and requires 3,000 to 4,000 pounds of ground limestone to correct its acid condition.
The most extensive use of this soil is for the growing of corn, wheat, and tobacco. A small proportion of it is in forest and pasture. The tree growth in forests includes various oaks, dogwood, black locust, hickory, and black gum. In the open country smilax, dewberries, hawkweed, ragweed, foxtail, crabgrass, and broomseed are common native plants. Pastures are only fair, as about 4 acres of land is necessary to support one 1,000-pound steer.

Under good management the yields of corn are 30 to 45 bushels; of wheat, 15 to 18 bushels; and of tobacco, 1,500 to 1,800 pounds.

Elliber silt loam.—The 6- to 8-inch surface layer of Elliber silt loam is light-brown or grayish-brown smooth silt loam. This material grades into light-yellow or brownish-yellow heavy silt loam or friable silty clay loam, which continues to a depth of 18 to 20 inches. The subsoil is friable yellowish-brown silty clay that becomes hard and brittle when dry. At a depth of 32 to 35 inches the subsoil grades into mottled or streaked light-brown, brownish-red, ochreous-yellow, or light-gray silty clay loam that may be crushed easily to a soft mass. This layer of soil material overlies limestone at a variable depth, ranging from about 45 to considerably more than 60 inches.

Included with this soil as mapped are small areas of Clarksville silt loam, which differs from the Elliber soil mainly in the color of the surface soil and subsoil. The surface soil of the included soil is light-gray or grayish-yellow smooth silt loam, and the subsoil is yellow or light reddish-yellow friable silty clay that is hard and brittle when dry.

Elliber silt loam has developed from material derived from weathered impure limestone and dolomitic limestone. The limestone in places contains chert, and a few chert fragments are on the soil and in the soil layers.

Only 256 acres of this soil is mapped. It occurs in scattered areas, the largest of which are northeast and southeast of Hansonville.

The surface of this soil ranges from moderately sloping to rolling, and the slopes range from about 8 to 15 percent. Owing to its smooth surface, the land is favorable for the cultivation of crops. Surface drainage and internal drainage are good.

Most of the soil is used for the production of field crops, mainly corn, wheat, and grass (for hay and pasture). A 4-year rotation of corn, wheat, hay, and grass is a good practice on this soil. Tobacco does well, and a few small areas are planted to it. Corn may be expected to yield about 40 bushels an acre on land well fertilized and manured; wheat, about 15 bushels; tobacco, 1,200 to 1,500 pounds; and hay crops, 1 to 2 tons of hay. Small areas are used for pasture, and 3 to 4½ acres produce sufficient pasturage for one 1,000-pound steer.

Elliber silt loam, hilly phase.—This soil represents areas of Elliber silt loam having a slope of 15 to 30 percent. The surface soil and the subsoil are similar in color, texture, and structure to those layers of the typical soil, although in some places the subsoil is not so thick. Because of the comparatively steep slope, the soil is not so easily cultivated as typical Elliber silt loam.

The total area of this soil is 448 acres. Most of the individual areas are within a radius of a few miles of Hansonville.
Owing to its steeper slopes, this soil is more subject to erosion than typical Elliber silt loam. The soil is used mostly for field crops. Some areas are in pasture, and about 4 acres of pasture land will support one 1,000-pound steer. The crops grown, fertilizers applied, and crop rotation practiced are the same as on the typical soil, but yields are slightly lower.

Elliber cherty silt loam.—The surface layer of this soil consists of brown or grayish-brown silt loam that becomes light grayish brown when dry. At a depth of 6 to 8 inches this material passes into brownish-yellow friable silty clay loam, which continues to a depth of 15 to 18 inches. The upper part of the subsoil is light-brown or slightly brownish yellow friable silty clay that contains faint mottles of very light gray and ochersous yellow. The lower subsoil layer, at a depth of 30 to 35 inches, is underlain by light-brown, very light gray, and ochersous-yellow friable crumbly silty clay loam containing very small particles of white decayed chert and black mineral matter. Many light-gray and brownish-yellow chert fragments, from one-eighth to one-half of an inch in diameter, are strewn over the surface and mixed with the surface soil, and from 15 to 35 percent of the surface layer is composed of chert fragments. These small chert fragments are so numerous that they give the soil a gravelly appearance. Light-yellow or almost white decomposing chert fragments are embedded in the subsoil.

The soil is underlain at a variable depth by impure limestone and dolomitic limestone, which contain much chert. On weathering, these rocks break down into soft material from which the soil is derived. Many chert fragments have resisted weathering and remain as gravel on the surface and in the soil layers.

Elliber cherty silt loam covers 704 acres. The largest bodies are in the eastern part of the county about 2 1/2 miles east of Belfast Mills near the Russell-Tazewell County line and southeast of McClothlin School. Several smaller bodies are around Hansonville.

The land is moderately sloping or rolling, although in some places it is undulating to gently rolling. The slope ranges from 3 to 15 percent, but in most places it is between 8 and 15 percent. Because of the favorable relief, the land is nearly everywhere suitable for the use of improved farm machinery. Erosion has caused some waste of the surface soil and has formed a few shallow gullies in places. Both external and internal drainage are good.

A large part of the land is cleared. On the wooded areas the trees include various oaks, hickory, black gum, sourwood, dogwood, black locust, and black walnut. In places dead chestnut trees appear among the other trees. A small part of the soil is in pasture. The pasture plants consist of bluegrass, crabgrass, and lespedeza. Broomsedge, foxtail, hairy spurge, aster, and dewberries grow in many pastures. Pasturage on 3 1/2 to 4 1/2 acres of this soil furnishes grazing for one 1,000-pound steer.

The main crops are corn, wheat, other small grains, and hay. Tobacco is produced in small areas on some farms. Most of the crops are grown in a 4-year rotation of corn, wheat or other small grain, hay, and grass. Under good management corn yields 35 to 45 bushels an acre; wheat, 13 to 16 bushels; and tobacco, 1,200 pounds. Clover returns 3/4 to 1 1/2 tons of hay.
Bolton loam, rolling phase.—Most areas of this soil are rolling, with slopes that range from 3 to 15 percent, and probably one-fourth of the total area is undulating with slopes of about 3 to 8 percent. In color, texture, and structure of the surface soil and the subsoil, this soil is similar to typical Bolton loam, which occupies much steeper slopes. The subsoil layer in some places is thicker than in the typical soil.

Although Bolton loam, rolling phase, occurs in many places, the total area is only 768 acres.

Because of the moderate slope, the land is favorable to the use of heavy farm machinery. The soil is porous and absorbs rain water readily. Erosion is moderate, although here and there it has considerably altered small areas. The soil has good tilth and is fairly easy to plow.

Nearly all of the land is used for field crops. Corn, wheat, oats, hay, and grass (for pasture) are the main crops. Tobacco is grown in small fields on some areas. Corn produces 15 to 25 bushels an acre on unfertilized land and somewhat higher yields on fertilized land. Wheat yields range from 12 to 20 bushels on fertilized land, and tobacco 1,200 to 1,800 pounds. Oats make good yields. Leespedezia and timothy give good returns of hay. Garden vegetables yield well, and apple and peach trees make fair yields.

A small part of the soil is in pasture, and an area of about 4 acres affords pasturage for one 1,000-pound steer.

A crop rotation practiced on this soil is as follows: First year, corn or tobacco; second year, wheat or other small grain; third year, a hay crop; and fourth year, grass.

Bland silty clay loam, rolling phase.—The surface layer of Bland silty clay loam, rolling phase, is dark purplish-brown heavy silt loam, which grades into dark grayish-brown rather heavy silty clay loam at a depth of about 2 inches. This material breaks into angular soil particles, ranging from about one-eighth to one-half inch in diameter. The surface soil apparently contains a comparatively large quantity of humus, which is well incorporated with the mineral soil. On drying, the color of the surface soil changes to light grayish brown with a purple cast. The subsoil begins at a depth of about 6 inches and consists of dark purplish-brown fairly heavy plastic silty clay, which, when dry, forms angular particles that are hard and consequently difficult to crush. Black specks of mineral material are present in the subsoil in fairly large numbers. At a depth of about 24 inches the subsoil passes into dark purplish-brown friable smooth silty clay loam, in which are dark-brown decayed fragments of shale. Underlying this material at a depth of 30 to 40 inches are alternate beds of purplish-red and gray limestone.

This soil occupies only 64 acres, mainly along Cedar Creek, in the central part of the county.

Although areas of this soil are predominantly rolling, they are smoother than the areas of typical Bland silty clay loam. The slope ranges from 8 to 15 percent. Surface drainage is good to excessive, and subsoil drainage is somewhat retarded by the dense clay composing this layer. Bedrock outcrops in some places. Most of the drainage channels may be crossed by heavy farm machinery. Limestone sinks have formed in the land, but they are generally far
apart. The soil is slightly acid in reaction. Because of the heavy texture of the soil, good tilth is difficult to obtain.

This soil is used mainly for the production of corn and grasses. A good 4-year rotation of crops consists of corn the first year, hay crops for the 2 succeeding years, and grass the fourth year. Small-grain crops do not thrive well on this soil. Several areas are used for the production of alfalfa, and two cuttings are obtained in a season, each yielding about 1 to 1 ½ tons of hay an acre. This soil is well suited for the production of alfalfa. Timothy and clover make a good growth and yield well. Corn yields 45 to 60 bushels an acre on land that is limed and treated with 200 pounds of 20 percent superphosphate. Where the soil is fertilized with phosphatic fertilizer, grass makes a good stand.

The tree growth includes various oaks, black walnut, black locust, redecedar, hackberry, black gum, and sassafras.

**Carbo silty clay loam, rolling phase.**—The rolling phase of Carbo silty clay loam occupies more moderate slopes than the typical soil. The land is prevailing rolling, although a small part of it is undulating; and the slope ranges from 3 to 15 percent. The color, texture, and structure of the surface soil and subsoil resemble those features of the corresponding layers of typical Carbo silty clay loam, but the surface soil and subsoil are nearly everywhere slightly thicker. The soil is much more favorable for the cultivation of crops than the typical soil.

Carbo silty clay loam, rolling phase, comprises 576 acres. The soil occurs in the southeastern part of the county, northeast and northwest of Rockdell and east and northeast of Elk Garden, and in the south-central part northeast of Hansonville.

Surface drainage is good, but internal drainage is somewhat retarded by the heavy clay subsoil. Wherever possible the land is used for field crops. Some areas produce fair pasture. Bluegrass, crabgrass, and white clover are the main pasture plants. Broomsedge, hawkweed, wild strawberry, horsemint, wild carrot, and aster grow in some pastures. The few trees that remain are redecedar, various species of oaks, black walnut, black locust, and black gum. Redcedar apparently makes a better growth than the other trees on this soil.

Corn, wheat, and hay are the principal crops, and oats and barley are less extensively grown. Crops produce slightly higher yields on this soil than on the typical soil, but the fertilizers applied and methods practiced are practically the same on the two soils.

**Tumbez silty clay loam.**—The 8- to 12-inch surface soil of Tumbez silty clay loam is dark-gray or gray heavy silty clay loam or silty clay containing particles and small fragments of almost white partly decomposed limestone. In some places the surface soil is faintly yellowish brown and not quite so heavy as the darker colored soil, and in some places it is only 5 or 6 inches thick. Underlying the surface soil is gray or dark-gray plastic silty clay intermixed with nearly white soft decomposed limestone. At a depth of 15 to 24 inches this material gives way to almost white soft limestone. This soil is unusual for this part of the country, as it is calcareous throughout and reacts freely when treated with hydrochloric acid. The soil is locally known as “bald hill land.” The underlying bedrock
is highly calcareous limestone, and on weathering it breaks down into almost white platy fragments.

This soil occupies 820 acres. The largest bodies are in the eastern part of the county near and about 1 mile north of Repass, southeast of Elk Garden School, and southwest of Elk Garden; in the south-central part near Jessie School; and in the central part near Spring City.

This soil occupies hilly land, with the slope ranging from 15 to slightly more than 30 percent. External drainage is good, but internal drainage is not so good because of the denseness of the clay subsoil and the nearness of bedrock to the subsoil. The slow movement of water brings about a moisture condition favorable to the growth of grass. Runoff, although somewhat rapid, has caused only a moderate loss of soil. Because of the rather steep slope, the soil is not so favorable for the cultivation of crops as Tumbez silty clay loam, rolling phase, which has a much more moderate slope.

This soil is used mainly for the production of corn, hay, and grass. Very little wheat is grown. The soil produces the best quality of bluegrass in the county, and it is also especially well suited to the growing of alfalfa and clover. On one farm corn produced an average of 50 bushels an acre for a period of 11 years without any application of fertilizer to the land. Corn returns about 55 bushels and wheat 20 bushels on land fertilized with 200 pounds of 4-12-4 fertilizer or 20 percent superphosphate, other management practices being good. Under good management tobacco yields about 1,300 pounds. Alfalfa yields about 1 ton of hay at each cutting, and two or three cuttings are made. Clover produces about 2 tons of hay.

The pasture plants are mainly bluegrass, crabgrass, and white clover, and in some pastures orchard grass and red clover grow. A sparse growth of Indian grass and broomsedge appears in some places. A few black walnut, oak, redcedar, black locust, and black gum trees grow in places.

**Hayer loam, hill phase.**—Hayer loam, hill phase, resembles typical Hayer loam in color, texture, and structure of the surface soil and subsoil. This soil, however, occupies steeper land than the typical soil, the slope ranging from about 15 to 30 percent, or slightly more in a few places. Because of the steeper slope, the soil is not so well suited to the growing of cultivated crops as the typical soil.

Only 384 acres of this soil is mapped. It occurs mainly in the eastern part of the county along the Little River near Barrett School and near Belfast Mills; in the southern part, east and northeast of Jessie School; and in the southwestern part near Collinwood.

Both external and internal drainage are good, and the soil has been subject to only slight erosion. It is slightly acid in reaction. In order to obtain good yields of crops, fertilizer must be applied to the land.

A large part of the land is cropped. Under good management corn, the leading crop, yields 35 to 45 bushels an acre, and wheat about 12 bushels. Oats are grown on some areas and are cut green. Barley gives fair yields but is not an important crop on this soil. Some areas are in pasture, and the pasture ranks medium to high in carrying capacity. Bluegrass, crabgrass, and white clover are the main pasture plants.
Greendale silt loam.—The 8- to 14-inch surface soil of Greendale silt loam consists of light grayish-brown or light grayish-yellow friable silt loam that is somewhat darker when wet. The subsoil, which continues to a depth of 30 to 35 inches, is brownish-yellow or yellow friable silty clay loam underlain by a layer of brownish-yellow friable rather compact silty clay loam containing spots and streaks of dark brown, ocherous yellow, and very light gray. In this material small particles of black matter are present. Many small angular chert fragments are on the surface and in the soil in some places. The surface soil and the subsoil vary somewhat in texture and structure. Fine sand or very fine sand is present in places in such quantities as to make the surface soil fine sandy loam or very fine sandy loam and the subsoil friable fine sandy clay or very fine sandy clay. This soil is formed from materials washed from nearby slopes, and the texture and structure depend to a large extent on the character of the soil on the nearby slopes, which are underlain by calcareous shale, mixed shale and limestone, mixed sandstone and limestone, or limestone.

Greendale silt loam has a small total area—448 acres. Small narrow bodies border many small drainageways throughout the county, one of the largest being east of Munseys Chapel.

The surface of Greendale silt loam is nearly level or undulating, and the slopes that it occupies range from about 2 to nearly 8 percent. The soil lies well for the cultivation of crops. Drainage is fair to good, but in some of the nearly flat areas the movement of water through the soil is slow.

Corn, wheat, and hay are the principal crops. Tobacco is planted on small areas on some farms (pl. 4, B). Under good management corn yields from 35 to 50 bushels an acre; wheat, 15 to 18 bushels; hay crops, 1 to 2 tons of hay; tobacco, 1,200 to 1,500 pounds. Some of the land is in pasture, and the pasturage is fair. A rotation of crops practiced by some farmers includes corn or tobacco, wheat, and a hay crop for 2 years, or the grass may be used as pasturage the fourth year.

Greendale silt loam, slope phase.—The slope phase of Greendale silt loam occupies moderately sloping areas—8 to 15 percent or more in gradient—in contrast with the nearly level and undulating areas occupied by typical Greendale silt loam. Otherwise this soil is similar to typical Greendale silt loam.

The slope phase of Greendale silt loam covers 704 acres. It is in the eastern, northeastern, northwestern, central, and southwestern parts of the county.

Drainage is good in both the surface soil and the subsoil. The land lies favorably for the growing of cultivated crops.

Most of the soil is cleared and used for growing corn, wheat, and hay. Some small areas are planted to tobacco. Crop yields, fertilizer treatment, and rotation of crops are about the same as on Greendale silt loam. A small part of the land is in pasture.

Sequatchie loam.—The 10- to 15-inch surface soil of Sequatchie loam consists of brown mellow loam that apparently contains a fairly large quantity of humus. The subsoil is composed of faintly yellowish brown friable slightly plastic silty clay loam containing a few black mineral specks. At a depth of 30 to 32 inches the subsoil grades
into a material that in some places is brown or yellowish-brown soft friable fine sandy clay and in others is mottled brown and ocherous-yellow friable silty clay mixed with soft decomposed pieces of purple shale and brown sandstone. A few black mineral particles are present. In some places this material is underlain by sandstone gravel at a depth of about 45 inches. Included with this soil as mapped are a few small areas of Sequatchie silty clay loam, which has a much heavier textured surface soil and subsoil than Sequatchie loam.

Sequatchie loam has developed on terraces and high bottoms from materials of alluvial origin. The material consists of fine soil particles that have been washed from uplands underlain mainly by sandstone and shale and some limestone and deposited near streams by running water.

Only 192 acres of this soil is mapped. It occurs in the eastern, southeastern, northern, northwestern, central, and southwestern parts of the county.

This soil occupies almost level to undulating areas having a 2- to 8-percent slope. Because of the gentle slope, nearly all of the land is favorable to the use of farm machinery. Drainage is good. The soil is medium to strongly acid. Crops respond readily to fertilization, and complete fertilizer gives the best results. Some farmers, however, do not use fertilizer on this soil.

Practically all of the land is used for the production of field crops, and the soil ranks medium to high in productivity. Corn, small grain, hay, and tobacco are the main crops. Under good management, corn yields 45 to 50 bushels an acre; wheat, 15 to 20 bushels; hay, 1 to 2 tons; and tobacco, 1,200 to 1,800 pounds.

Sequatchie loam, slope phase.—The slope phase of Sequatchie loam occurs on slopes ranging from about 8 to slightly more than 15 percent. The soil is similar in physical characteristics to Sequatchie loam, and it is separated from that soil mainly because of its steeper slopes.

The total area of this soil is only 128 acres. Small bodies border the Little River and Indian Creek in the northeastern part of the county and Moccasin Creek in the southwestern part.

Because of the steeper slope, this soil is not so easily cultivated as typical Sequatchie loam. It is well drained, however, and has good tilth. The reaction ranges from medium acid to strongly acid.

Most of the land is planted to field crops, mainly corn, hay, wheat, and tobacco. The fertilizer treatment and the yields of crops are practically the same as on Sequatchie loam.

Lindside silt loam.—The 10- to 15-inch surface soil of Lindside silt loam is brown or light-brown friable silt loam. The subsoil is mingled light grayish-brown and dark-brown friable crumbly silty clay loam containing specks, small spots, films of black mineral matter, and soft decomposed shale particles. At a depth of 28 to 32 inches this material is underlain by light-gray or gray somewhat plastic and rather heavy silty clay loam, showing small spots of dark brown and ocherous yellow. Small black mineral particles and small black pieces of partly decomposed shale are present in this material in many places. Brown fibrous vegetable matter in a partly decomposed state appears in some places. Angular and subangular frag-
ments of limestone and chert, 1 to 3 inches in diameter, lie beneath the soil in places at a depth of about 40 inches.

Lindside silt loam has developed from alluvial material in first bottoms along some of the streams. The material from which the soil is formed was washed from slopes underlain mostly by impure limestone and deposited near streams by running water.

The total area of this soil is 1,728 acres. It occurs chiefly in the eastern part of the county along Indian and Cedar Creeks and their tributaries. Several bodies are along Moccasin and Copper Creeks and their tributaries.

This land is nearly level to gently sloping. Surface drainage is fair to good, but internal drainage is poor.

Lindside silt loam is used mainly for the growing of corn and hay or as permanent pasture land. Permanent pasture occupies areas that are too wet or too broken for cultivated crops. Several areas have been tile drained, and the condition of the soil has been so improved that crops have given increased yields. Corn produces fair yields in normal seasons but makes its best yields in dry seasons. It returns 30 to 45 bushels an acre in normal seasons and 50 to 55 bushels in dry seasons. Cornland is not fertilized. When the land is treated with 20 percent superphosphate, the yields of grass (for pasture and hay) increase.

Hay crops yield from 1½ to 2 tons—in some places as much as 2½ tons. Pasture grasses thrive well. From 1 to 2½ acres affords pasture for one 1,000-pound steer. Bluegrass, crabgrass, white clover, and timothy are the main pasture plants. Broomsedge appears in some pastures. Alder bushes and reeds grow on poorly drained areas, many of which are too small to indicate on the map. Black willow and weeping willow grow in places near the stream banks.

Pope fine sandy loam.—The 15- to 18-inch surface soil of Pope fine sandy loam is brown mellow fine sandy loam that is somewhat lighter brown when dry. The subsoil consists of light-brown or brown friable crumbly fine sandy clay, which at a depth of 28 to 35 inches passes into light-brown slightly looser loamy soil material that contains slightly coarser sand particles. In places dark-brown spots are present. Water-worn sandstone gravel underlies this layer in places at a depth of about 40 inches. In places water-worn sandstone rocks and pebbles are on the surface and embedded in the soil, and they compose about 30 percent of the soil mass. The water-worn rocks are about 4 to 10 inches in diameter, and the pieces of gravel are from 1 to 4 inches. These stony and gravelly areas, such as those north of Carbo, are indicated on the soil map by symbols.

Pope fine sandy loam lies in first bottoms near streams and consists of alluvial deposits of fine soil material washed from slopes underlain mainly by noncalcareous sandstone and shale.

The total area of this soil is 960 acres. Most of the bodies border the Clinch and Little Rivers. Several areas are in the southwestern part of the county along Moccasin Creek.

Pope fine sandy loam occupies almost level to gently sloping areas. External drainage is slow, but internal drainage is rapid. The soil apparently contains a moderate quantity of organic matter, but it is deficient in lime. From 2,000 to 4,000 pounds of ground limestone an acre would probably correct the acidity. The soil requires fertilizer in order to produce the best yields of crops.
Nearly all of the land is used for the growing of corn, oats, hay, and tobacco. Potatoes and garden vegetables are grown for domestic use in small areas. A good practice in the production of crops consists of a 8-year rotation of corn, tobacco, and a hay crop.

Under good management corn yields 25 to 40 bushels an acre; oats, 35 bushels; and tobacco, 900 to 1,200 pounds. Potatoes and garden vegetables yield fairly well.

**Pope silt loam**—The 10- to 15-inch surface soil of Pope silt loam consists of brown or dark-brown silt loam containing considerable very fine sand in places. When dry, the surface soil is somewhat lighter in color and in places has a purple tinge imparted by material derived from purple sandstone and shale. Some brown and purplish-red sandstone fragments, from 2 to 6 inches in diameter, are on the surface and in the soil in places. The subsoil is light-brown or yellowish-brown silty clay loam or fine sandy clay, which can easily be crushed to a soft mass. At a depth of 32 to 35 inches the subsoil passes into light-brown friable crumbly soil material containing spots of ocherous yellow, dark brown, and light gray and soft partly weathered sandstone and shale particles. Coatings or films of black mineral matter appear in places in this soil material, particularly in the upper part. Included with this soil as mapped are several areas of Huntington silt loam that are too small to show separately. Included also are areas of Pope fine sandy loam that are too small to warrant indicating on the map.

Pope silt loam is in first bottoms near streams, and the material from which it is formed consists of fine soil material washed from slopes underlain mostly by noncalcareous shale and fine-textured sandstone and deposited near the streams by running water.

The total area of this soil is 448 acres. It occurs chiefly along the Clinch River. A fairly large body lies along Cedar Creek northeast of Old Rosedale.

Pope silt loam occupies nearly level to gently sloping areas. It apparently contains a moderate to rather large quantity of organic matter and is medium acid in reaction. Fertilization with phosphate and potash is required for good crop yields. Drainage is fair to good.

Practically all of the land is used for the production of corn, wheat, and hay. Corn yields 35 to 50 bushels an acre without fertilizer. Ordinarily, wheat produces 15 bushels and hay crops about 2 tons of hay. Tobacco is grown on some small areas, and ordinarily it yields about 1,500 pounds an acre. A good practice in crop production consists of a 3-year rotation of corn, small grain, and hay.

**THIRD-CLASS SOILS**

The Third-class soils include Frederick cherty silt loam, hilly phase; Lodi loam, hilly phase; Elliber cherty silt loam, hilly phase; Clarksville cherty silt loam; Clarksville cherty silt loam, hilly phase; Clarksville cherty fine sandy loam; Bolton loam; Westmoreland silt loam, rolling phase; Westmoreland silty clay loam, hilly phase; Bland silty clay loam; Carbo silty clay loam; Wellston loam; Jefferson fine sandy loam; Jefferson fine sandy loam, hill phase; Holston loam; Holston loam, slope phase; Pope sandy loam; and Philo fine sandy loam.
The combined area of the Third-class soils is approximately 54 square miles, or about 11 percent of the area of the county. The soils are distributed mostly in the lowland belt and are underlain mainly by limestone, although some of them are underlain by limestone interbedded with shale and sandstone. A few of the soils are derived from colluvial material consisting of sandstone and shale fragments deposited at the base of mountains and on valley floors, and a few have formed from alluvial material near streams. Among the unfavorable characteristics of these soils, which disqualify them for inclusion in the First-class or Second-class soils, are hilly or steep relief, an abundance of chert fragments on the surface and in the soil, shallowness or impervious character of soil layers, poor moisture conditions, and low fertility. Some of the soils are similar in relief to some of the First-class soils, but large quantities of chert or the impoverished condition of the parent material prevent these soils from producing as high yields. Lodi loam, hilly phase, is not quite so productive as Dunmore silt loam, hilly phase.

Members of the Frederick and Elliber series included as Third-class soils carry a large quantity of small chert fragments both on the surface and in the surface soil. The surface layer of members of the Clarksville series is light grayish-yellow, light yellowish-brown, or light brownish-gray friable silt loam or fine sandy loam, which passes at a depth of about 8 inches into a 6- or 8-inch layer of light brownish-yellow heavy silt loam or light silty clay loam. The subsoil is light yellowish-brown or slightly brownish yellow friable silty clay. On the surface and in the soil are a great many small light-gray angular fragments of chert and, in places, fragments of sandstone, 3 to 6 inches in diameter. These soils are considerably leached in the surface layer, and, because of the many chert fragments, the downward movement of moisture through the soil is rather rapid.

Bolton loam occupies much steeper slopes than Bolton loam, rolling phase, classed as Second-class soil; consequently it is not so desirable for cultivation. Members of the Westmoreland series are light brown, grayish brown, or brown in the surface soil and yellowish-brown, light-brown, or reddish-brown friable silty clay in the subsoil. Westmoreland silt loam, rolling phase, and even Westmoreland silt loam, hilly phase, have a much milder relief than typical Westmoreland silt loam, which is a Fourth-class soil. The surface layer of Westmoreland silty clay loam, hilly phase, is grayish brown and heavy, and the soil breaks down to fine angular particles. Considerable organic matter appears to be mixed with the surface soil. Bland silt loam and Carbo silt clay loam are hilly and occupy much steeper slopes than Bland silt clay loam, rolling phase, and Carbo silt clay loam, rolling phase, both Second-class soils.

The soils of the Wellston series have yellowish-brown, light brownish-yellow, or light grayish-yellow surface soils and brownish-yellow, light-brown, or yellowish-brown friable heavy loam or fine sandy clay subsoils. The soil is developed from the weathered products of noncalcareous sandstone and shale. In some places the sandstone under this soil is arkosic, that is, it contains feldspar.

The soils of the Jefferson series have gray or light-gray friable surface soils, and yellow or faintly brownish yellow friable fine sandy clay subsoils. The soils are developed from the weathered products of sandstone and shale fragments that have rolled from moun-
A. Strip cropping on Frederick cherty silt loam, hilly phase, a practice being adopted by many farmers. B. View on Copper Ridge. Tobacco and corn on areas in which Frederick cherty silt loam, hilly phase, other Frederick soils, and Bolton, Lock, Clarksville, and Greendale soils predominate.
A. Small cultivated patches, which for the most part, are confined to the more gently sloping areas of the soils of the fourth class.  

B. Hagerstown stony silty clay loam. Numerous outcrops of limestone make the land unfit for crop production but do not greatly reduce its value for permanent pasture.
tain slopes and spread in places on valley floors. Members of the Holston series have brownish-yellow surface soils and brownish-yellow or yellow friable fine sandy clay or silty clay loam subsoils. They have developed on terraces near streams from fine soil material that has been washed from soils on uplands underlain principally by noncalcareous sandstone and shale and has been deposited near streams. The Holston soils are lighter colored than the Sequatchie soils, which are developed on low terraces and high first bottoms.

The member of the Pope series in this group is light-brown or brown friable sandy loam or loamy sand underlain at a depth of about 18 inches by light-brown friable sandy clay or heavy sandy loam. It differs from Pope fine sandy loam, a Second-class soil, in being slightly lighter colored, somewhat more friable, and slightly coarser textured. Its productivity is somewhat lower than the productivity of Pope fine sandy loam.

The surface soils of the Philo soils are grayish brown or light brown and friable. The subsoils consist of mottled gray and dark-brown friable fine sandy clay, which at a depth of about 30 inches passes into gray slightly plastic heavy fine sandy clay spotted with brown. Drainage is fair in the surface soil but poor in the subsoil. The soil has formed from alluvial material in first bottoms near streams. This alluvial material consists of fine soil particles derived from soils on slopes underlain by noncalcareous sandstone and shale.

The soils in this group are used in the production of corn, hay, and wheat. Small areas are planted to tobacco, and some are in pastures. Crop yields generally are lower than those on the Second-class soils.

Frederick cherty silt loam, hilly phase.—In color, texture, structure, content of chert, and depth this soil is similar to typical Frederick cherty silt loam. It differs from the latter soil mainly in having a steeper slope—from 15 to 30 percent—whereas the slope of the typical soil ranges from 3 to 15 percent. Because of its steeper slope, this hilly soil is less easily cultivated and is more subject to erosion than typical Frederick cherty silt loam.

Frederick cherty silt loam, hilly phase, occupies an area of 15.4 square miles. One almost continuous belt extends from Collinwood in the extreme southwestern part of the county northeastward to Repass. Several bodies are along the Little River and elsewhere.

Runoff is rapid in many places and probably has reduced the thickness of the surface soil considerably in small areas. Internal drainage of this soil is good, and many surface drainage channels occur, a large proportion of which are difficult to cultivate across. Small outcrops of limestone bedrock are present here and there. The organic-matter content is low, and the reaction is medium acid. As the natural fertility is only fair, complete fertilizers are necessary, in order to obtain the best crop yields on this soil, and, as erosion of the cultivated land is a problem, strip cropping should be practiced, in order to conserve the soil (pl. 5, 4).

Much of this soil is used for the growing of field crops. Some areas are in pasture, and some are in forest. Corn, wheat, hay, and grass are the leading crops, and tobacco is a fairly important crop (pl. 5, B). Oats are grown on some areas.
Under good management, corn yields from 30 to 40 bushels an acre; wheat, 12 to 15 bushels; tobacco, 1,000 to 1,800 pounds; oats, 18 to 25 bushels; and hay crops, $\frac{3}{4}$ to 1$\frac{1}{2}$ tons of hay. A good practice followed in the production of crops on this soil seems to be a 4-year crop rotation of corn or tobacco, wheat or other small grain, a hay crop, and grass for pasture. About 4 or 5 acres of the land is required to provide grazing for one 1,000-pound steer. The pasture plants include bluegrass, crabgrass, meadow fescue, sheep fescue, and lespedeza. Other plants growing in places in the pastures are broomseed, foxtail, fleabane, hairy spurge, aster, and dewberries.

Small areas here and there are in forest. The forest growth includes various oaks, black gum, hickory, sourwood, dogwood, black locust, and black walnut.

**Lodi loam, hilly phase.**—In color, texture, and structure of the surface soil and subsoil, this soil is similar to typical Lodi loam. It differs from that soil in that it has, in some places, a thinner surface soil and subsoil, and in its steeper slope, which ranges in gradient from 15 to 30 percent. The soil does not lie so well for cultivation as typical Lodi loam.

This soil has an aggregate area of 7 square miles. Some of the largest bodies are in the eastern part of the county between the Little and Clinch Rivers and around Elk Garden. The soil is widely distributed in the eastern, northeastern, central, northwestern, western, and southwestern parts.

Because of its hilliness, this land is subject to serious erosion, if unprotected, and in places much of the surface soil has been carried away by the rapid runoff. Shallow gullies have formed in some places. Many short drainageways have cut into the slopes but their channels do not prevent the use of heavy farm machinery. Drainage is good. Bedrock outcrops in very few places. The soil apparently is low in organic matter. The reaction is medium acid.

A smaller part of this soil than of Lodi loam is cleared of forest and is in agricultural use. The forest trees include various oaks, dogwood, black locust, hickory, and black gum, and there are a few dead chestnut trees. Smilax, dewberry vines, hawkweed, ragweed, foxtail, crabgrass, and broomseed grow in places on the cleared land. Some areas are in pasture. The pasture yield is comparatively low, and 4 to 6 acres is required to furnish pasturage for one 1,000-pound steer.

Corn and wheat are the principal crops grown. Tobacco and oats are produced on small areas of the soil on some farms. Under good management, corn yields 25 to 35 bushels an acre, wheat about 11 bushels, oats 15 to 20 bushels, and tobacco 1,200 to 1,500 pounds.

Because of the steeper slope and marked erodibility of this soil, an 8-year rotation of crops seems to be better than the 4-year rotation practiced on typical areas of Lodi loam, if proper management practices are followed. An 8-year rotation considered good includes corn, wheat, a hay crop, and grass for 5 years instead of 1 year, thereby protecting the soil against erosion for a longer period.

**Elliber cherty silt loam, hilly phase.**—This soil is similar in color, texture, structure, and chert content to typical Elliber cherty silt loam, but it occupies steeper slopes and therefore is less desirable for crops. It occupies slopes or hilly country of about 15- to 30-
percent gradient. Surface drainage and internal drainage are good. On some of the steeper slopes rapid runoff has brought about moderate surface erosion and the formation of small gullies in places.

The soil covers 7.5 square miles. It occurs throughout all except the extreme northern and southeastern parts of the county. One of the largest areas is near Hansonville.

A large part of the land is cleared. In forested areas the trees are of the same species as those on Elliber cherty silt loam. A larger proportion of the soil is in pasture than of the typical soil, and the pasture plants are about the same on the two soils. About 4 acres produces pasturage for one 1,000-pound steer.

Corn, wheat, hay, and grass are the main crops grown. Corn produces 25 to 35 bushels and wheat 12 to 15 bushels an acre when the land is well managed. Hay crops produce ¾ to 1⅓ tons of hay.

Clarksville cherty silt loam.—The 6- to 10-inch surface soil of this soil is light grayish-yellow, yellow, or light yellowish-brown friable silt loam, which grades into a light brownish-yellow or faintly grayish-yellow friable and slightly brittle silty clay loam subsoil. At a depth of 35 to 38 inches the subsoil passes into mingled or mixed brown, dark-brown, ochreous-yellow, and very light gray silty clay containing friable decomposed chert and small black mineral particles. At a depth of about 45 inches this material gives way to mingled brown, ochreous-yellow, dark reddish-brown, and very light gray smooth crumbly silty clay derived from decayed chert and shale. Small black mineral particles and black mineral films are in evidence. Limestone bedrock lies from 48 to 72 or more inches below the surface. Many angular chert fragments, ranging from ⅛ to 3 inches in diameter, are scattered over the surface and throughout the surface soil and subsoil. These fragments give the soil a distinctly gravelly or cherty appearance, and they compose 25 to 35 percent of the soil mass. The chert is dark gray or almost black on the fresh fracture, but on weathering becomes light gray or brownish yellow. In forested areas the 1- or 2-inch surface layer is dark gray or grayish brown, because of an accumulation of partly decayed vegetable material in the topmost part of the soil.

This soil has formed from the weathered material of dolomitic limestone containing much chert. The weathering forces that broke down the limestone left large quantities of small chert fragments undisturbed, and these became a predominant constituent of the soil.

Only 449 acres of Clarksville cherty silt loam is mapped. Areas of the soil are in the central part of the county near Copper Ridge School and Munseys Chapel, near Mount Olive Church, and near Dickensonville.

The slope ranges from 3 to 15 percent, but in most places it is between 7 and 15 percent, and the surface ranges from undulating to rolling. Practically all of the land lies favorably for the use of heavy farm machinery. Both external and internal drainage are good. As the runoff is moderate, erosion has not greatly altered the soil. The soil almost everywhere is deficient in organic matter, and the surface soil in most places is considerably leached.

A large part of the land is cleared. The tree growth in the forested areas includes white oak, black oak, red oak, pin oak, red
maple, tuliptree, sourwood, dogwood, hickory, black gum, and some black walnut. Dead chestnut trees remain in some places. A small proportion of the land is in pasture, and the pasture plants are chiefly undesirable grasses and weeds, such as aster, daisy, sheep sorrel, bushclover, sandbur, speedwell, broomsedge, hairy spurge and blackberry and dewberry vines. The carrying capacity of the pasture is fair to low.

Corn, wheat, other small grains, hay, and grass are the leading crops. Tobacco is grown in small areas on some farms. Under good management, corn yields 25 to 35 bushels an acre; wheat, 10 to 15 bushels; and tobacco, 1,200 to 1,500 pounds. Hay crops give fair to low yields. A good cropping practice on this soil is a 4-year rotation consisting of corn, small grain, hay, and grass for pasture.

Clarksville cherty silt loam, hilly phase.—In color, texture, structure, and quantity of chert present on the surface and throughout the soil, this soil is not essentially different from typical Clarksville cherty silt loam. It is separated on the soil map mainly because the land is more hilly.

The total area of this soil is about 8.7 square miles. An almost continuous belt extends from Lawson Store northeastward to a point north of Lebanon. Areas are around Hansouville, and smaller bodies are scattered over other parts of the county.

The slopes range from 15 to 30 percent. Surface drainage is rapid, and internal drainage is sufficient. Runoff has washed away a part of the surface soil from a few small areas, and small gullies have formed in a few places. The soil is low in organic-matter content in most places, and the surface soil is much leached.

A large part of the land is covered with forest. The trees are white oak, black oak, red oak, pin oak, tuliptree, red maple, dogwood, sourwood, hickory, black gum, and a few black walnut. Blight has killed the chestnut trees, but some of the dead trees are still standing. Some of the soil is in pasture, and it ranks medium to low in the production of pastureage. The pasture plants are the same as those growing on the typical soil.

Because of its steeper slope, this soil is not so useful for cultivated crops as Clarksville cherty silt loam. The main crops grown on this hilly land are corn, wheat and other small grains, hay, and grass. Tobacco is produced to a small extent on some areas. Yields of crops are slightly lower than those obtained on Clarksville cherty silt loam, although the fertilizer treatment used and the crop rotation practiced are similar on the two soils.

Clarksville cherty fine sandy loam.—The 8-inch surface soil of Clarksville cherty fine sandy loam is light yellowish-brown, light grayish-brown, or light-brown friable fine sandy loam or loam. The subsoil is brownish-yellow or yellow friable silty clay loam that contains many light-gray or light-yellow chert fragments and light-brown sandstone fragments ranging from one-fourth to 2 inches in diameter. At a depth of about 32 inches the subsoil is underlain by light-brown friable crumbly silty clay material mottled with slightly reddish brown, ocherous yellow, and light gray. It contains partly decomposed yellowish-brown chert and small pieces of light-brown weathered sandstone. Fine-textured light-brown sandstone and, in places, gray limestone underlie this soil material at a depth of 48
or more inches. Light-gray angular chert fragments, from \(\frac{1}{4}\) to 4 inches in diameter, are strewn over the surface and intermixed with the soil. Mixed with the chert on the surface and in the soil are many light-brown rectangular fragments of sandstone from \(\frac{1}{4}\) to 6 inches long. These fragments of chert and sandstone are so numerous that they give the soil a gravelly or stony appearance. In forested areas, to a depth of about one-half inch the surface layer consists of dark-brown or grayish-brown fine sandy loam, the dark color being due to an accumulation of a fairly large quantity of organic matter composed of partly decayed leaves and twigs. The rest of the surface soil is light yellowish-brown friable fine sandy loam that shows spots or splottes of dark brown. The thick-bedded cherty dolomite containing thin to comparatively thick beds of sandstone underlies this soil, and the soil has developed from weathered dolomite, sandstone, and chert of this formation.

Clarksville cherty fine sandy loam covers only 128 acres, mainly along Tumbling Creek in the extreme eastern part of the county and southwest of Lebanon near Willis School.

The land is undulating to rolling with slopes ranging from 3 to 15 percent. Only a very small part of the land, however, has a slope of 3 to 8 percent. Both surface and internal drainage are good. Limestone sinks are few, but springs are plentiful and large. Most of the drainageways cannot be crossed with heavy farm machinery. Gully erosion is moderate, but sheet erosion has reduced the surface soil considerably in places. The organic-matter content of the soil is low in cleared areas. From 3,000 to 5,000 pounds of ground limestone is required to correct the acidity of this soil.

Much of the land is in forest, and the trees consist of white oak and other oaks, tuliptree, dogwood, red maple, hickory, sourwood, and pine. A small part is in pasture, and the quality of the pasture is low. Crabgrass, foxtail, broomsedge, smilax, ragweed, sheep sorrel, narrow-leaved and broad-leaved plantain, life everlasting, wild rose, oxeye daisy, wild strawberry, wild carrot, ironweed, pennyroyal, dandelion, mullein, sour grass, aster, nettle, hawkweed, and dewberry vines grow in the pastures and on the open land.

The principal crops grown on this soil are corn, wheat, other small grains, and hay. Tobacco is grown on small areas on some farms. Under good management, corn produces 15 to 35 bushels an acre; wheat, 10 to 12 bushels; oats, about 25 bushels; and tobacco, 800 to 1,200 pounds.

**Bolton loam.**—The surface soil of Bolton loam is brown mellow loam about 8 inches thick, and it apparently contains considerable humus. Small black mineral concretions are present in many places. When dry the surface soil is light brown, and when wet it is dark brown. The subsoil consists of yellowish-brown, reddish-brown, or mingled brown and light yellowish-brown friable heavy loam, fine sandy clay, or clay loam, containing a great many small black mineral concretions. At a depth ranging from about 32 to 35 inches the subsoil gives way to mingled dark reddish-brown, brown, and yellowish-brown friable silty clay loam, which also contains many small black mineral concretions. Partly decomposed and decomposed chert fragments, ranging in color from almost white to almost black, are mixed with this material. In some places decomposed brown sand-
stone fragments also are mixed with the material. A few gray chert fragments and brown sandstone fragments are on the surface and in the surface soil and subsoil.

The depth to bedrock is probably 25 feet or considerably more. The bedrock is perhaps a formation of impure limestone including beds of sandstone of variable thickness.

Bolton loam covers about 5 square miles. Some of the largest areas are in the western part of the county along Copper Ridge and Moccasin Ridge. Bodies of this soil are scattered throughout all except the extreme northern and southeastern parts.

This soil occupies strongly rolling and hilly land, with slopes that range from about 15 to 30 percent. Because of the rather steep slope, the land is not so favorable for cultivation as Bolton loam, rolling phase, which has a much gentler slope. The surface soil is porous, and rain water soaks in readily, although erosion is active in places. Greater care must be taken in protecting this soil against erosion by growing cover crops and by correct plowing than is necessary on Bolton loam, rolling phase.

Much of the land is used in the growing of corn, wheat, oats, and hay. Tobacco is a minor crop on some areas. Corn produces from 35 to 40 bushels an acre, wheat 12 to 15 bushels, and oats return fair yields. Where properly fertilized, tobacco returns 1,200 to 1,800 pounds an acre. Lespedeza and timothy give fair returns of hay. Some areas are in pasture, and 4 or 5 acres affords enough grazing for one 1,000-pound steer.

The uncleared areas of this soil support a growth of various oaks, dogwood, black locust, hickory, and black gum. Dead chestnut trees remain in some places among the other trees. Small native vegetation growing in pastures includes crabgrass, foxtail, hawkweed, ragweed, broomsedge, smilax, and dewberry vines.

Some farmers practice a 4-year rotation of corn or tobacco, wheat or other small grain, a hay crop, and grass for pasture.

**Westmoreland silt loam, rolling phase.**—The 6-inch surface soil consists of light-brown or grayish-brown friable silt loam. The subsoil is yellowish-brown or reddish-brown friable silty clay that becomes less friable and more compact at a depth of 15 to 18 inches. At a depth of 24 to 30 inches the subsoil grades into brown or mingled brown and dark-red friable silty clay loam containing small soft decayed fragments of shale. Alternate beds of limestone and shale underlie the soil at a depth of 36 inches or slightly more. Thin pieces of yellow, green, and brown soft shale are present in the lower part of the subsoil.

In some areas, such as those south of Cleveland, there are numerous outcrops of rock, and these areas are indicated on the soil map by symbol. Because of the outcrops, such areas are suited to pasture rather than to cultivated crops.

Only 320 acres of this soil is mapped, mainly southwest of Castlewood and near Cleveland.

This soil includes the smoothest areas of Westmoreland silt loam, and it is rolling, in contrast with the hilly and steep relief of areas of typical Westmoreland silt loam. The slope ranges from 8 to 15 percent. Drainage is good. Small areas here and there are eroded.
A large part of this soil is in pasture, mainly of bluegrass and crabgrass. About 3 or 4 acres of the soil produce enough pasturage for one 1,000-pound steer.

Corn, wheat, and hay are grown on some areas. Corn yields 30 to 40 bushels an acre and wheat 10 to 15 bushels. Clover gives fair returns of hay.

Westmoreland silty clay loam, hilly phase.—The 5- or 6-inch surface soil consists of grayish-brown heavy silty clay loam that breaks down into fine angular soil particles. Apparently the surface soil contains a fairly large quantity of well-decomposed vegetable matter. The subsoil is composed of yellowish-brown heavy silty clay loam, which passes into light yellowish-brown rather tenacious silty clay at a depth of 12 to 15 inches. At a depth of 24 to 30 inches the subsoil is underlain by mingled or mottled ocherous-yellow, brown, and dark reddish-brown friable silty clay, which, in turn, is underlain by interbedded limestone and shale at a depth of about 36 inches.

As mapped, some undulating and low areas of this soil include soil formed from material washed from the higher slopes. This included soil is inextensive.

The total area of Westmoreland silty clay loam, hilly phase, is only 1.1 square miles. This soil occurs almost entirely in the southeastern part of the county on the slopes of Clinch Mountain, but a few areas are on the slopes of Big A Mountain in the north-central part.

The slopes occupied by this soil nearly everywhere range from about 8 to 30 percent in gradient. The surface is rolling to hilly, and the soil is more suitable for cultivation than Westmoreland silty clay loam, which occupies steeper slopes. Surface drainage is good, but internal drainage is slow. Slight erosion is evident in a few places as soil slips and shallow gullies. The soil seems to contain a moderate quantity of organic matter and is medium to slightly acid. For good yields of crops it requires treatment with complete fertilizer.

Corn, wheat, and hay are grown on a fair proportion of the land. Tobacco is grown in small fields on some farms. Corn returns from 25 to 40 bushels an acre, and wheat and hay crops make fair returns. This soil supports good pastures, and 2½ to 3½ acres affords enough grazing for one 1,000-pound steer. The better practice on this soil consists of a 4-year or longer rotation of corn, small grain, hay, and pasture.

Bluegrass and crabgrass are the main pasture grasses, and orchard grass and timothy grow in some pastures. In some open country poverty oatgrass, broomsedge, horsemint, wild carrot, and aster grow.

Small wooded areas remain in places, and the principal trees are black locust, black walnut, and various oaks.

Bland silty clay loam.—To a depth of about 2 inches the surface layer consists of dark purplish-brown heavy silt loam in which is incorporated an appreciable quantity of humus derived from decayed grass and leaves. Beneath this thin layer is the subsurface layer of dark grayish-brown fairly heavy silty clay loam, which breaks into small angular soil particles, one-eighth to one-fourth of an inch in diameter. When dry the surface soil is light grayish brown with
a purple hue. The subsoil, which begins at a depth of about 6 inches, is dark purplish-brown rather heavy plastic silty clay, the purple being more pronounced on a cut surface than on a broken one. The clay of the subsoil breaks into angular particles, one-eighth to one-half inch in diameter, which are hard and rather difficult to crush. Many black mineral specks are distributed throughout the subsoil. At a depth of 20 to 28 inches the subsoil gives way to dark purplish-brown friable smooth slick silty clay loam, intermixed with dark-brown decomposed fragments of shale that are coated with black on the cleavage planes. At a depth of 24 to 36 inches this material overlies purplish-brown, dark-purple, purplish-red, and dark-gray limestone, the latter being interbedded with the purple limestone. The soil is locally known as red limestone land.

Bland silty clay loam comprises a total area of 1 square mile. It occurs mainly in the eastern part of the county near Harmony Hall Church, east of Belfast Mills, and north of Barnett Church; in the central part, south of Miller View Church and southeast of Lebanon; and in the western part, near Dye Chapel. Near the crest of Clinch Mountain in the southwestern part, the soil occupies steeper slopes than elsewhere, the slopes being 60 percent or more.

Most of Bland silty clay loam occupies hilly areas, although in some places the land is steep. The maximum range in slope is from 15 to 60 percent. Runoff is rapid, but internal drainage is slow, because of the denseness of the clay subsoil. The soil is erodible, and in places much of the surface soil has been washed away. Limestone sinks have formed here and there, and bedrock outcrops in places. As the soil is slightly acid in reaction, it requires 1,500 to 2,000 pounds of ground limestone an acre, or 800 to 1,000 pounds of burnt lime to correct the acidity.

Most of the soil is comparatively shallow and is closely related to the parent material. Cover crops are required in order to prevent serious erosion. Because of the heavy soil texture, good tilth is difficult to obtain.

The most extensive use of the land is for pasture. Pasture plants include bluegrass, crabgrass, and, in some pastures, white clover, foxtail, and fescue. Broomsedge, wild carrot, hawkweed, wild strawberry, dogfennel, and thistle grow in some places in pastures. On the more moderate slopes 3 or 4 acres of this soil afford enough pasturage for one 1,000-pound steer.

A small part of the land is planted to crops, the most important of which are corn and hay. A 4-year crop rotation of corn 1 year, hay crops 2 years, and pasture 1 year is a good one to follow. Corn on the gentler slopes yields 40 to 60 bushels an acre, and hay crops yield about 1½ tons of hay.

The tree growth on uncleared areas includes various oaks, black walnut, black locust, redbud, hackberry, black gum, red maple, and sassafras.

Carbo silty clay loam.—The 5- or 6-inch surface soil of this soil is slightly grayish brown silty clay loam or heavy silt loam containing a small quantity of well-decomposed organic matter. It is underlain by a subsoil the upper part of which is yellowish-brown or mingled ocherous-yellow and brown heavy slightly plastic silty clay loam. At a depth of about 12 inches this material changes to yellowish-brown,
reddish-brown, or, in places, brownish-red heavy plastic silty clay, which passes, at a depth of 20 to 24 inches, into ochrous-yellow or greenish-yellow friable silty clay loam containing soft decomposed light greenish-yellow shale fragments. A brown mineral film covers the breakage planes of the shale fragments in places. At a depth of about 32 to 35 inches the soft material rests on limestone in which are strata of clayey material and thin seams of yellowish-brown shale. Thin beds of purple shale are present in the limestone in a few places.

The total area of this soil is about 1.6 square miles. It occurs in the eastern part of the county, chiefly south of Stone Mountain; in the southeastern part, near Price Chapel; and in the central part, near Munseys Chapel.

Carbo silty clay loam occupies hilly areas having slopes of 15 to 30 percent. Surface drainage is good, and on the steeper areas it is rapid, except where the slopes are covered by grass. Internal drainage is retarded somewhat by the heavy clay subsoil.

A fairly large part of the soil is used for the production of corn, wheat, hay, and grass for pasture. Oats and rye are grown to a small extent. A 4-year rotation of corn, wheat or other small grain, hay, and grass is common. This seems to be a good practice for the more gently sloping areas, but a longer rotation or strip cropping probably would be better for the steeper areas, both for increased yields of crops and for protection of the soil from erosion.

On good grass sod land and under good management, corn yields 35 to 40 bushels an acre. On the areas of lighter textured soil, wheat produces from 12 to 15 bushels. Oats and barley give good returns on the areas of lighter textured soil, but the yields are not so good on the heavier textured soil. Crops on this soil generally are grown in comparatively small fields. Apparently the tomato is the only vegetable that returns good yields at the present time.

Bluegrass, crabgrass, white clover, and red clover are the main pasture plants. Broomedge, hawkweed, hairy spurge, wild strawberry, horsemint, mountain-mint, jimsonweed, wild carrot, aster, moth mullein, thistle, and peppergrass are common in some pastures.

The tree growth includes various oaks, reedcedar, black walnut, black locust, black gum, and different scrub trees. With the exception of reedcedar, none of the trees seems to thrive.

**Wellston loam.**—The 8- to 10-inch surface soil of Wellston loam is yellowish-brown or light-brown mellow loam. When dry it is light grayish brown. In pastures or forests the 2- or 3-inch surface layer is brown or grayish brown, the darker color being caused by the presence of humus. The subsoil consists of brownish-yellow or light-brown friable fine sandy clay or heavy loam, which, at a depth of 30 to about 35 inches, is underlain by brownish-yellow, brown, and dark reddish-brown friable crumbly silty clay loam containing mixed soft decomposed sandstone and shale.

Only 128 acres of this soil is mapped, mainly in the northeastern part of the county near Drill and West Raven.

This soil has a slope of 5 to 15 percent. Erosion is not severe, and the land lies favorably for cultivation. Both external and internal drainage are good. The soil is deficient in organic matter and is acid in reaction. It requires from 2,000 to 4,000 pounds an acre of ground limestone to correct the acidity. The crops respond readily to fertilizer treatment.
A fairly large part of the area of this soil is used for growing field crops, mainly corn, wheat, oats, and hay. Corn yields from 25 to 35 bushels an acre, wheat 12 to 15 bushels, and winter oats 25 bushels, when the land is adequately fertilized. Red clover yields about 1 to 11/2 tons of hay to the acre, where limed and fertilized. Sweetpotatoes do fairly well. Potatoes produce about 100 bushels an acre on fertilized land. Garden vegetables and apple trees yield well.

A small part of the soil is used for pasture, and it ranks comparatively low in value of the pasturage it affords. The forested areas have about the same species of trees as those growing on Muskingum loam.

**Jefferson fine sandy loam.**—The 8- to 12-inch surface soil of Jefferson fine sandy loam consists of gray or light grayish-brown friable crumbly fine sandy loam. The subsoil is yellow or faint brownish-yellow friable fine sandy clay, which, at a depth of about 30 inches, passes into reddish-yellow or brownish-yellow friable light fine sandy clay.

This soil has been formed from decayed fragments of sandstone and shale that accumulated in beds near the foot of mountains. In some places limestone fragments are mixed with the sandstone and shale fragments.

Jefferson fine sandy loam covers an aggregate area of only 192 acres, mainly in the eastern part of the county south of Stone Mountain, in the southeastern part near Denniston Church, and in the north-central part near Big A School.

This land ranges from undulating to moderately sloping, the slope ranging from 3 to 15 percent. The soil almost everywhere lies favorably for the cultivation of crops. External and internal drainage are good. Erosion has caused a slight loss of surface soil in some places and a few shallow gullies in others.

Most of the land is cleared and is in use for the production of corn, wheat, hay, and grass. Tobacco is grown on small areas on some farms. A good rotation is corn, wheat or tobacco, a hay crop, and grass for pasture the fourth year.

Under good management, corn yields from 20 to 35 bushels an acre, wheat 10 to 15 bushels, and tobacco 1,000 to 1,200 pounds. Hay crops yield 1/2 to 1 ton of hay. Yields of potatoes are fair. Pastures have a low carrying capacity.

**Jefferson fine sandy loam, hill phase.**—The 7- to 9-inch surface soil of this soil is grayish-brown friable fine sandy loam that is light grayish yellow or light gray when dry. The subsoil consists of light brownish-yellow or yellowish-brown friable fine sandy clay that continues to a depth of about 30 inches. Beneath the subsoil the soil material is composed of mottled or streaked brownish-yellow and ochorous-yellow friable crumbly fine sandy clay or loamy fine sand. In places almost white and light-yellow disintegrating fragments of sandstone are mixed with the soil material. In other places a few purple decayed fragments of sandstone and yellow soft decayed fragments of shale are also present in the soil material.

This soil has a small total area—448 acres. It occurs in the southeastern part of the county southwest of Harmony Hall Church, in
the north-central part around Big A School, and in the northwestern part near Hamlin.

This soil includes areas having slopes of 15 to 30 percent or slightly more. Because of the somewhat steeper slopes, this soil is not so good as the typical soil for cultivated crops. Surface drainage is good to rapid, and internal drainage is good. Some surface soil has been carried away in places by runoff, and shallow gullies have been formed.

The soil is used mainly for cultivated crops and pasture. The crops grown, rotation practiced, and fertilizer treatment given are the same as for Jefferson fine sandy loam. Yields of crops, however, are somewhat lower than on that soil. Pastures are poorer than those on nearby areas of Westmoreland silt loam.

**Holston loam.**—When wet, the 8-inch surface soil of Holston loam is brownish-yellow mellow loam, which becomes light grayish brown when dry. The subsoil is brownish-yellow or yellow friable fine sandy clay to a depth of 28 to 32 inches, where it passes into brownish-yellow friable crumbly fine sandy clay containing small spots or narrow streaks of ocherous yellow, dark brown, or dark reddish brown. A few black mineral specks and films are in this material in places.

Included with this soil as mapped are small areas of Holston fine sandy loam and Holston silt loam. The silt loam has a finer and more compact surface soil and a finer subsoil than either the loam or the fine sandy loam. It consists of faint brownish-yellow somewhat plastic silty clay or silty clay loam, which, at a depth of about 32 inches, grades into mottled or streaked brownish-yellow, dark-red, and light-gray friable compact silty clay loam.

Holston loam is formed from sand, silt, and clay deposited on terraces near streams. This material was washed from soils on slopes underlain principally by noncalcareous sandstone and shale.

The total area of this soil is 1.5 square miles. The larger bodies border the Clinch River and tributaries that join the river from the north. Smaller bodies border Moccasin Creek.

The land is almost level to undulating, and the slope ranges from 2 to 8 percent. The soil lies well for the use of farm machinery and for the cultivation of crops. The surface soil is well drained, but in some places internal drainage is not well established. Apparently the organic-matter content of the soil is low. The reaction ranges from medium acid to very strongly acid. In order to correct the acid condition it is necessary to use 2,000 to 4,000 pounds an acre of ground limestone. For good yields of crops the soil requires a complete fertilizer.

Most of the soil is planted to field crops. Some areas support a tree growth of sassafras, locust, tuliptree, willow, and sycamore. Small native vegetation in open places includes spurge nettle (sand nettle), running briers, and broomedge.

Corn, wheat, hay, and oats are the principal crops. Tobacco is grown in small fields in places. Small areas are used in the production of potatoes and garden vegetables for domestic use. Where the land is fertilized and well managed, corn produces 25 to 40 bushels an acre, or 15 to 20 bushels where no fertilizer is used. Wheat yields
about 16 bushels an acre, timothy and clover \( \frac{3}{4} \) to 1\( \frac{1}{2} \) tons of hay, tobacco 1,000 to 1,200 pounds, and oats about 20 bushels. Potatoes and garden vegetables give fair returns.

**Holston loam, slope phase.**—The surface soil and the subsoil of Holston loam, slope phase, are similar in color, texture, and structure to the corresponding layers of typical Holston loam, but they differ from that soil in having a steeper slope—8 to 15 percent, or, in places, slightly more.

This soil occupies 1 square mile, chiefly in association with the typical soil along the Clinch River.

Because of the steeper slope, this soil is not so favorable for cultivation as typical Holston loam. The soil has good surface and internal drainage. Apparently the organic-matter content is low. The soil ranges from medium acid to very strongly acid. It requires lime and a complete fertilizer in order to produce good crop yields.

Nearly all of the land is used for the production of field crops. The crops and fertilizer treatment are similar to those for typical Holston loam, and the yields are practically the same. Locust, tuliptree, sassafras, willow, and sycamore grow on small areas.

**Pope sandy loam.**—The surface soil of Pope sandy loam is light-brown or brown friable sandy loam or loamy sand about 18 inches thick. The subsoil is light-brown friable sandy clay or heavy sandy loam, which continues to a depth of 32 to 35 inches. In some places the lower part of the subsoil contains more sand and is slightly more friable than the upper part. Dark-brown spots are present in the lower part of the subsoil in places. Beneath the subsoil the material consists of light-brown loamy sand and sandstone gravel. This soil is slightly lighter colored, more friable, and coarser textured than Pope fine sandy loam.

The total area of this soil is only 448 acres. Narrow strips border streams north of the Clinch River, especially in the northeastern part of the county.

Pope sandy loam occupies first bottoms near streams. The soil has developed from sandy material washed from slopes underlain mainly by sandstone and deposited near streams by running water.

The land ranges from almost level to gently undulating. Owing to its openness and porosity, the soil is well drained throughout. A small quantity of organic matter is mixed with the upper layer of the soil. From 2,000 to 4,000 pounds an acre of ground limestone is necessary to correct the acidity of the soil.

Almost all of the land is cropped, and corn and oats are the leading crops. Tobacco is grown on a few small areas. Garden vegetables, sweetpotatoes, and potatoes are grown for domestic use. Small orchards produce apples for home needs on some farms. Under good management, corn yields about 25 bushels an acre on land that has been fertilized, oats yield from 10 to 25 bushels without fertilizer, and tobacco makes fair returns on land treated with a complete fertilizer. Sweetpotatoes and potatoes produce about 100 bushels an acre. Garden vegetables thrive and make good yields.

**Philo fine sandy loam.**—The 10- to 12-inch surface soil of Philo fine sandy loam consists of grayish-brown or light-brown friable fine sandy loam. The subsoil is mottled gray and dark-brown friable sticky fine sandy clay, which, when crushed, breaks down to a soft
dark grayish-brown mass. At a depth of 28 to 32 inches the subsoil passes into light-gray or gray slightly plastic heavy fine sandy clay containing small spots of dark brown and ocherous yellow. This material, at a depth of about 40 to 45 inches, is underlain by sand and small rounded pebbles of sandstone gravel. In some places soft decomposed purple sandstone and shale are mixed with the material of this layer and give it a purple hue. The surface soil in some places is very fine sandy loam instead of fine sandy loam.

The soil occurs in narrow strips in first bottoms near streams, and it lies only a few feet above the normal level of the streams. The surface ranges from almost level to gently undulating. Surface drainage is fair, but subdrainage is poor. The soil is developed from fine soil material that has been washed from slopes underlain by non-calcareous shale and sandstone and has been deposited along the streams by running water.

Less than 1 square mile of this soil is mapped. The largest bodies border streams in the northwestern part of the county, especially Lick, Dumps, and Weaver Creeks and their branches. Other bodies are along Cedar Creek near Rosedale and along streams in the northern part of the county.

Philo fine sandy loam is used mostly for the growing of field crops. Some areas are in pasture. Corn, wheat, and oats are the leading crops. In general, corn produces 30 to 40 bushels an acre, oats about 20 bushels, and wheat 10 bushels. Tobacco is grown in some places, and the yields are good, provided the season is dry. Potatoes, planted on some of the well-drained spots, yield about 50 bushels an acre. Garden vegetables do very well, and small areas are planted to home gardens.

FOURTH-CLASS SOILS

The group of Fourth-class soils includes Hagerstown silt loam, steep phase; Hagerstown stony silty clay loam; Frederick cherty silt loam, steep phase; Lodi loam, steep phase; Elliber cherty silt loam, steep phase; Clarksville cherty silt loam, steep phase; Bolton loam, steep phase; Westmoreland silt loam; Westmoreland silty clay loam; Upshur-Litz silt loams; Carbo silty clay loam, steep phase; Frederick-Elliber stony silt loams; Frederick-Elliber stony silt loams, steep phases; Bland stony silty clay loam; Bland stony silty clay loam, steep phase; rolling stony land (limestone material); Hayter stony loam; Hayter stony loam, hill phase; Jefferson stony fine sandy loam; Jefferson stony fine sandy loam, hill phase; Melvin silty clay loam; Atkins fine sandy loam; and alluvial soils, undifferentiated.

The combined area of these soils is about 157.7 square miles, or 34 percent of the area of the county. The soils are distributed in the lowland belt and on some mountain slopes. Most areas of these soils are undesirable or unfit for cultivation but are well suited for pasture. Many of them are too steep for cultivation; some are undulating, rolling, or hilly but have many stones on the surface and in the soil; and poor drainage prevents some of them from being used for cultivated crops in most places.

Those areas of Hagerstown silt loam, steep phase, and those of Frederick cherty silt loam, steep phase; Elliber cherty silt loam, steep phase; and Clarksville cherty silt loam, steep phase, having a slope of 60 percent or more are probably better suited to forest than to
pasture, because of the rapid action of erosion when the soil is cleared of forest. Lodi loam, steep phase, contains a considerable proportion of fine sand in the surface soil. The soil is readily eroded unless protected by a cover of forest or grass.

The Frederick, Elliber, and Clarksville soils in this group are characterized by a large number of chert fragments on the surface and in the soil. The soils of the Westmoreland series in this group occupy hilly or steep areas and are underlain by limestone and shale in alternate beds. Limestone outcrops in some places in these soils, and shale bedrock lies near the surface in other places. Carbo silty clay loam, steep phase, is grayish brown in the surface soil and yellowish-brown or reddish-brown rather heavy and plastic silty clay in the subsoil. This land is too steep and too erodible for cultivated crops.

Small limestone outcrops make up about 15 to 40 percent of the area of Hagerstown stony silty clay loam; Frederick-Elliber stony silt loams; Frederick-Elliber stony silt loams, steep phases; Bland stony silty clay loam; and Bland stony silty clay loam, steep phase. Rolling stony land (limestone material) also is characterized by many small limestone outcrops, which occupy from 40 to 90 percent of the surface of the land. The soil among the rocks is not well developed and varies in characteristics from place to place.

Hayer stony loam; Hayer stony loam, hill phase; Jefferson stony fine sandy loam; and Jefferson stony fine sandy loam, hill phase, have many sandstone fragments on the surface and throughout the soil.

Melvin silty clay loam is a poorly drained soil in first bottoms near some streams. It has developed from material that was washed from soils on uplands underlain by limestone and deposited along the stream by running water. Atkins fine sandy loam is poorly drained and has developed from alluvial material deposited in first bottoms near some streams. This alluvial material was derived from nearby slopes underlain principally by noncalcareous shale.

Alluvial soils, undifferentiated, a miscellaneous land type of first bottoms, is variable; and the soil materials were washed down from slopes underlain by calcareous and noncalcareous rocks and deposited near streams by running water. Drainage is imperfect in many places.

A large part of each of the Fourth-class soils is in pasture, and a small part is in forest. Patches here and there of Hagerstown silt loam, steep phase, and of the Frederick, Elliber, Clarksville, and Westmoreland soils on the gentler slopes are planted to crops (pl. 6, A). Some small areas of Hagerstown silt loam and Jefferson stony fine sandy loam are used for field crops. A few small areas of Melvin silty clay loam have been reclaimed by tile drainage and have become useful in the production of crops.

On the whole, the soils in this group, because of steep slope, stoniness, or imperfect drainage, are poorly suited to cultivation, and they can be used to best advantage as pasture land.

**Hagerstown silt loam, steep phase.**—Hagerstown silt loam, steep phase, comprises the steepest areas of Hagerstown silt loam. The slope ranges from 30 to 60 percent or slightly more. Because of the steepness of slope, the soil layers are not everywhere so thick as in
the typical soil, although the color, texture, and structure are similar. Cultivation is detrimental to such steep areas; therefore crops cannot be grown so economically on them as on the more gently sloping areas of typical Hagerstown silt loam.

The total area of this soil is less than 1 square mile. Areas occur in the eastern, northern, central, western, and northwestern parts of the county.

Owing to the rapid runoff, the soil soon deteriorates through erosion unless it is protected by a cover of grass or forest. Most of the soil is in pasture, and the principal pasture grasses are bluegrass and crabgrass. Broomsedge and dewberry vines are present in many of the pastures. The few forested areas support a growth of black locust, black walnut, redecedar, and a few oak trees. A small proportion of the soil is used as cropland, but yields are much lower than on the typical soil.

Pastures on this soil are fair, but the steepest areas are probably better suited to forestry than to pasture.

**Hagerstown stony silty clay loam.**—The 6- to 8-inch surface soil of this soil is brown or reddish-brown fairly friable silty clay loam. The subsoil is light-brown, reddish-brown, or dark-red friable but fairly heavy clay to a depth of 24 to 45 inches, or somewhat more, where it rests on limestone bedrock. Throughout the areas of this soil, numerous outcrops of gray limestone, 3 to 5 feet in diameter, rise a few inches to 2 or 3 feet above the surface of the land. These rock outcrops occur at intervals of several feet to about 20 feet. They occupy about 15 to 40 percent of the surface of the land, and their presence prevents the cultivation of crops or makes it very difficult. In some places small areas of 1 or 2 acres of soil that are practically free of outcrops can be used for cultivated crops.

Included with this soil as mapped are areas in which loose fragments of limestone, 6 to 8 inches in diameter, almost entirely cover the surface and are present in fairly large numbers in the soil (pl. 6, B). The soil here is dark-brown or almost black friable loam, which rests on limestone from a few to about 18 inches below the surface. This limestone breaks into fragments of different sizes, and the many loose stones on the surface and in the soil are the result of the breaking down of the bedrock into angular fragments. The soil is subject to rather severe erosion unless it is protected by a cover of grass or forest.

The relief ranges from undulating to hilly, and the slope ranges from 3 to 30 percent. Because the numerous outcrops make cultivation impracticable, the best use for the soil is pasture. In a normal season 3 or 4 acres of this land affords enough grazing for one 1,000-pound steer or 4 or 5 ewes.

The aggregate area of this soil is 7.2 square miles. The soil occurs in many parts of the county.

**Frederick cherty silt loam, steep phase.**—In color, texture, structure, and content of chert, this soil resembles Frederick cherty silt loam, but the surface soil and the subsoil are not so thick in many places as those in the typical soil. In most places the slope ranges from 30 to 60 percent, but in a few places it is between 60 and 80 percent. Frederick cherty silt loam, steep phase, is distinguished
from the typical soil and from the hilly phase because of its steeper slopes, which make it less well adapted to cultivation.

Frederick cherty silt loam, steep phase, occupies 9.3 square miles. It occurs mainly within a belt extending from Point Truth, in the southwestern part of the county, northeastward reaching the Russell-Tazewell County line between the Little and Clinch Rivers. Areas lie on both sides of Moccasin Creek in the southwestern part of the county and along Cedar and Indian Creeks in the southeastern part.

Because of its steep slope, Frederick cherty silt loam, steep phase, is better suited to pasture than to cultivated crops. The greater part of the soil is used as pasture land, although pastures on this soil are medium to low in productivity. The runoff of rain water from the steep slopes is rapid in cleared areas, and the soil is subject to considerable erosion unless it is protected by a cover of grass. The soil appears to be low in organic-matter content and in natural fertility.

Some small areas lying on the gentler parts of the slopes are planted to corn, wheat, and tobacco. The fertilizer and lime requirements are about the same as on the typical soil and the hilly phase. Corn produces about 20 bushels an acre.

Crops on this steep land need to be grown in a longer rotation than crops on typical Frederick cherty silt loam. A rotation of crops considered good for use on this steep land consists of corn or tobacco the first year, wheat or other small grain the second year, a hay crop the third year, and a grass crop (for pasture) the 5 succeeding years. By this long rotation the soil would be better protected from erosion and from leaching than by a 4-year rotation.

About 5 acres of this soil is required to produce enough grazing for one 1,000-pound steer. Bluegrass, crabgrass, meadow fescue, sheep fescue, and lespedeza are the main pasture plants. Broomsedge, foxtail, hairy spurge, fleabane, and aster grow in many pastures.

Forest covers some small areas, and the trees include different oaks, and black gum, hickory, sourwood, dogwood, black locust, and black walnut. In places dead chestnut trees remain among the other trees. The steepest areas of this soil are apparently better suited to forest than to pasture.

Included with Frederick cherty silt loam, steep phase, as mapped, are areas of Frederick silt loam, steep phase. These included areas are on slopes ranging from about 30 to 60 percent or somewhat more. In physical characteristics the soil is similar to Frederick silt loam, but in many places the surface soil and subsoil are not so thick. This included soil has a small total area. Areas of it are in the eastern, southeastern, central, southwestern, and western parts of the county. In general, this inclusion occupies areas too steep for use for cultivated crops, although some small areas are cropped. Runoff of rain water is rapid, and the soil washes rather severely unless it is protected by a cover of grass or forest. Much of the soil is used as pasture land, and it is medium to low in the quality of pasturage afforded.

Lodi loam, steep phase.—The steep phase of Lodi loam has a slope of 30 to 60 percent, or more in a few places. The surface soil and the subsoil resemble those layers of typical Lodi loam, although in many places these layers are not so thick. Because of its steep slope, this soil is better suited to pasture or forest than to cultivated crops.
About 6.1 square miles of this soil is mapped. The soil occurs chiefly in a belt extending from a point north of Point Truth northeastward to the Russell-Tazewell County line between the Clinch and Little Rivers. Several areas are along Cedar Creek from a point west of Elk Garden to a point beyond Rosedale.

This steep land is mainly in forest, and the trees include many of the same species as those on Lodi loam, hilly phase. Some of the less steep areas are used as pasture land. About 5 or 6 acres of the land is necessary to supply enough pasturage for one 1,000-pound steer.

If the soil is cleared of forest the land will become severely eroded unless erosion is prevented by a cover of grass. For this reason almost all of the areas of this soil that have been cleared of forest and cultivated as long as 2 years have been put back into forest or have been planted to pasture.

Elliber cherty silt loam, steep phase.—The surface soil and the subsoil of this soil are not everywhere so thick as those layers of typical Elliber cherty silt loam, owing to the steep slope—30 to 60 percent; otherwise the characteristics of the surface soil and the subsoil of the two soils are practically the same.

Because of its steepness this land is less desirable for cultivated crops than the typical soil. The best use for this steep land is for pasture, although the steepest areas are better suited to forest.

Some of the soil on the gentler slopes is planted to crops, mainly corn, wheat, and hay. The fertilizer treatment for corn and wheat is the same as for the same crops grown on Elliber cherty silt loam, but the yields are slightly lower. A considerable part of the soil is used as pasture land, and about 4 acres of it affords enough pasturage for one 1,000-pound steer.

Forests occupy a fairly large part of the land. The trees include various species of oaks, and hickory, dogwood, sourwood, black gum, black locust, and black walnut.

This soil covers a total area of 6.4 square miles. It occurs throughout the same southwest-northeast belt as Lodi loam, steep phase. In addition several large bodies lie north of the Clinch River in the northeastern part of the county, near Rosedale and Belfast Mills in the eastern part, around Hansonville, and north of Moccasin Creek.

Included with Elliber cherty silt loam, steep phase, as mapped, are areas of Elliber silt loam, steep phase. This included soil differs from Elliber cherty silt loam, steep phase, in having only a small number of angular chert fragments on the surface and throughout the soil. This inclusion is inextenstive. Areas of it are in the central part of the county west and north of Maple Grove Church.

This steep land is subject to serious erosion when cleared of forest unless it is protected by a cover of grass. Owing to steep slope and marked tendency to erode, this soil is better suited to pasture than to cultivated crops. Most of the cleared land is in pasture, and about 5 acres of the soil furnishes enough grazing for one 1,000-pound steer. A few small less steep areas of the soil are planted to field crops. Corn, wheat, and hay are the main crops grown. The yields of these crops are somewhat lower than on the typical soil, although the fertilizer treatment for corn and wheat is the same as for that soil,
Clarksville cherty silt loam, steep phase.—This soil has a slope of 30 to 60 percent, and in a few places it is somewhat steeper. It is similar to typical Clarksville cherty silt loam in color, texture, structure, and content of chert in the surface soil and subsoil, although in some places the soil layers are not quite so thick. The slope is too steep in most places to be suitable for growing cultivated crops.

The total area of this soil is about 3.9 square miles. Most of the individual areas are in a southwest-northeast belt, especially near Spring City and between the Little and Clinch Rivers. Several areas are in the northwestern part of the county northwest of Counts, in the southwestern part around Tumbez, in the south-central part within a few miles of Hansonville, north of Big Cedar Mill, and elsewhere.

The fertility of this soil is difficult to maintain because of the steep slope and rapid runoff. The soil is apparently deficient in organic matter and is considerably leached. Some of the more gently sloping areas are used for the production of corn, wheat, and hay. Cornland and wheatland are given the same fertilizer treatment as on Clarksville cherty silt loam, but the yields are considerably lower. The greater part of this soil is in pasture, although the productivity of the pastures is low.

Forest areas include red oak, sourwood, hickory, dogwood, and black gum. Dead chestnut trees remain among the other trees in some places. The steepest areas of this soil are probably better suited to forestry than to pasture.

Bolton loam, steep phase.—This steep phase of Bolton loam has a slope of 30 to 60 percent or, in a few places, more. The characteristics of the surface soil and subsoil are about the same as those of Bolton loam except that the layers are not everywhere so thick. This soil is not so good for cultivated crops as Bolton loam, which occupies much milder slopes.

The total area of this soil is about 5.9 square miles. The soil occurs throughout a southwest-northeast belt from Point Truth to the Russell-Tazewell County line between the Little and Clinch Rivers. An almost continuous area follows Copper Ridge in the southwestern part of the county. Several bodies are around Hansonville, Elk Garden School, and Harmony Church.

A fairly large part of the soil that occupies less steep areas is used for field crops, mainly corn, wheat, hay, and grass. Tobacco is planted on a few small areas. The fertilizer treatment for corn, wheat, and tobacco is the same as for the same crops on typical Bolton loam, but the crop yields are somewhat lower. To protect the soil on these steep slopes from erosion, an 8-year rotation of crops is considered effective. Such a rotation includes corn, wheat, and hay, after which the land is kept in grass for 5 years. The areas used as pasture land furnish fair grazing.

Forests occupy a small part of the soil. The trees include various oaks, dogwood, black locust, black gum, and hickory. The steepest areas are better suited to forest than to field crops and pasture.

Westmoreland silt loam.—The 5- or 6-inch surface soil of Westmoreland silt loam is light-brown, grayish-brown, or brown friable silt loam. The subsoil is yellowish-brown or slightly reddish brown
smooth friable silty clay, which at a depth of about 15 inches changes to light yellowish-brown somewhat compact and less friable silty clay. The upper part of the subsoil contains a few yellow, green, red, and brown soft shale particles, and the lower part contains a large number of such particles. At a depth of 24 to 28 inches the subsoil passes into brown or mingled brown and dark-red friable silty clay loam intermixed with soft decomposed shale. In some places the soft shale is about 15 inches or less below the surface. The soil is underlain by bedrock, consisting of interbedded limestone and shale, at a depth of 36 to 60 inches. Included with this soil as mapped are areas of Westmoreland silt loam containing many outcrops of bedrock. The outcrops are indicated on the soil map by symbols.

Westmoreland silt loam is developed from the residue of weathered interbedded shale and limestone. Most of the limestone is blue-banded; most of the shale is yellow or grayish green, and here and there it contains very thin layers of sandstone.

Westmoreland silt loam has a total area of about 24.7 square miles, of which the included stony soil represents about 6 square miles. The largest areas are on Moccasin Ridge, on River Mountain, and on the northern slopes of Clinch Mountain. Discontinuous areas extend from a point southeast of Nash Ford School northeastward to a point southeast of McGlothlin School. Areas are in the central part of the county near Big Cedar Mill and southwest and southeast of Lebanon; in the northwestern part near Hamlin, in the west-central part south of Pine Ridge, and in the north-central part south of Big A Mountain.

This soil occupies hilly and steep areas ranging in slope from 15 to 60 percent. External drainage is rapid, and on unprotected slopes it is excessive. Internal drainage is well established. Erosion has removed part of the surface soil in places, and shallow gullies have formed here and there. Many short drainageways have cut deep channels into the hillsides and slopes. Springs are scattered over the areas. Bedrock outcrops here and there on some of the hillsides. The organic-matter content of the soil is low, except in forested areas, where a small quantity of organic material is present in the upper part of the surface layer.

The most extensive use of this soil is for pasture. In permanent pastures that have been grazed closely, the pasture cover is mainly bluegrass and crabgrass; whereas, in fields that have been in cultivated crops for several years and then put in pasture, it is mainly broomsedge. In addition to bluegrass and crabgrass, white clover and orchard grass grow in some pastures. Small vegetation growing in some pastures are ground-ivy, dandelion, sour grass, yarrow, elephant’s-foot, silk grass, blue aster, fleabane, and spurge. The soil on the steeper slopes is suitable for the grazing of light-weight cattle and sheep. The pastures are medium in productivity, and 3 to 4 acres affords enough pasturage for one 1,000-pound steer. About 2 acres afford enough pasturage for one yearling steer or 4 or 5 ewes.

In the few forested areas that remain, the trees include black oak, hickory, black locust, wild cherry, tuliptree, dogwood, red maple, and redcedar.
The soil used for field crops is very acid. From 3,000 to 4,000 pounds of lime to the acre is required to correct this acid condition. From 2,000 to 3,000 pounds of lime to the acre is sufficient for permanent pastures.

**Westmoreland silty clay loam.**—The 5- to 6-inch surface soil is heavy textured. It consists of grayish-brown silty clay loam that breaks down into fine angular soil particles. A considerable quantity of decomposed organic matter apparently is well mixed with the mineral soil. The subsoil is yellowish-brown heavy silty clay loam, which at a depth of about 12 inches changes to light yellowish-brown slightly tenacious silty clay. This clay breaks down into irregular-shaped pieces from one-fourth to one-half inch in diameter. A few fine black mineral particles are present in the subsoil. At a depth of 12 to 24 inches the subsoil grades into mingled or mottled ochrous-yellow, brown, and dark reddish-brown friable silty clay loam containing a few black mineral particles. Bedrock composed of alternating layers of shale and limestone lies at a depth of about 30 to 36 inches below the surface.

Some areas of this soil contain numerous rock outcrops, which are indicated on the map by symbols.

Westmoreland silty clay loam is underlain by highly calcareous limestone and calcarceous shale in alternate layers (pl. 7, A). In some places the shale is noncalcareous, and in places the limestone is fossiliferous. The soil has developed from the weathered products of the underlying shale and limestone.

The total area of Westmoreland silty clay loam is about 10.5 square miles, and that of the included stony areas is very small. The soil occurs chiefly in the eastern part of the county on the slopes of House and Barn Mountain, River Mountain, Rich Mountain, and Bear Mountain and on the north slopes of Clinch Mountain Spur and Stone Mountain. Smaller areas are on the north slope of Clinch Mountain southeast of Hansonville and in the north-central part of the county northwest and north of Flatwoods.

The land has a slope ranging from 30 to 60 percent. Because of the steep slope, the soil is better suited to pasture than to cultivated crops. Surface drainage is rapid, but internal drainage is rather slow. Erosion, in the form of slip erosion and, to some extent, shallow gully ing, has been active here and there, but the areas affected are small. The soil contains a moderate quantity of organic matter, and the reaction is acid or slightly acid.

The land is used mainly for pasture, and because of the steepness of the slope this is probably the best use for it. The pasture cover includes bluegrass, crabgrass, and in some places orchard grass and timothy. Other plants in some pastures are poverty oatgrass, broomsedge, horsepasture, wild carrot, and aster. The carrying capacity of the pasture is fair, and 1 1/2 to 2 acres of this soil affords enough pasturage for one yearling steer.

Some areas are in forest. The trees are mainly black locust, white ash, wild cherry, dogwood, sugar maple, black walnut, red oak, black oak, sassafras, chestnut oak, and yellow buckeye.

**Upshur-Litz silt loams.**—This soil complex includes a purplish-red soil and a light-brown soil that are so closely associated that it is not practicable to separate them on the soil map. These two soils
A. Westmoreland silty clay loam developed on steep slopes over interbedded limestone and shale. The thicker layers are limestone; the thinner ones shale.  

B. Hayter stony loam. The stones are sandstone boulders and smaller fragments that have rolled down from the nearby mountains. Nearly all of the land is used for pasture, to which it is well adapted.
A type of home common in the northern mountainous part of Russell County. The soils of these steep areas are generally stony and shallow and are poorly suited to agriculture. Coal mining is an important industry and a number of people who work in the mines at least part of the time, live on small mountainous farms.
generally occur in about equal proportions, although in some places the purplish-red soil is more extensive and in other places the light-brown soil is more extensive.

Normally the surface soil of the Upshur soil is light purplish-brown, purplish-brown, or purplish-red fairly friable silt loam or heavy silt loam, 5 or 6 inches thick. When dry it is light grayish brown or light purple, and when wet it is light brown or brown. The subsoil consists of purplish-brown or purplish-red friable smooth slightly plastic silty clay to a depth of 12 to 18 inches, where it passes into mingled brown, dark purplish-brown, and dark purplish-red friable crumbly smooth silty clay, in places containing streaks of ocherous yellow. This material is composed mainly of partly decomposed shale. The soil is not everywhere so thick as the typical soil just described, and in places the decomposed shale is within a few inches of the surface or is exposed on the surface. Thin shale particles lie on the surface in many places, and a few brown sandstone fragments, 1 or 2 inches in diameter, are on the surface in some places.

The Litz soil has a 6-inch light-brown friable silt loam surface soil that is light grayish brown when dry. It is underlain by a yellowish-brown or brownish-yellow friable silty clay subsoil, which grades at a depth of 12 to 18 inches into light-brown silty clay mixed with brownish-yellow soft decomposed shale. On the surface and in the soil are a few light-brown soft shale particles. In some places the decomposed shale immediately underlies the surface layer or is exposed on the surface.

The underlying rock formation furnishing the mineral material for this soil is variable but consists mainly of red mudstone or shale. The formation includes shale, sandstone, limy clayey beds, dolomite, and blue pure limestone. The different rocks have formed in comparatively thin beds, which are distributed irregularly throughout the entire formation. Probably 75 percent of the formation consists of red mudstone and green sericite shale, which are present in definite layers as much as 50 feet thick. The sandstone occurs in thin beds in most places, is fine textured, and is brown or green. The calcareous clayey beds weather to yellowish ocher or, less commonly, reddish ocher, through the leaching of their limy content. The dolomite and limestone present compose possibly not more than 10 percent of the formation.

Included with this soil complex as mapped are areas in which there are many small outcrops of limestone bedrock. These outcrops are indicated on the soil map by symbol.

This complex occupies about 1.6 square miles, mainly in the north-central and northeastern parts of the county near areas of Westmoreland silt loam. The land is rolling to hilly, and the slope ranges from 8 to 30 percent. Because of the rather steep slope in many places and the shallowness of the soil over bedrock, these soils are subject to severe erosion when cleared of forest or unprotected by a cover of grass.

Most of the land is in forest consisting of black oak, hickory, black locust, wild cherry, tuliptree, dogwood, red maple, and redcedar. Pastures on this soil are fair to poor.

As the soil erodes easily and rock outcrops are numerous in some places, this soil complex is best suited to forest, although the more favorable areas seem to be suitable for pasture if shaded with locust or walnut trees.

**Carbo silty clay loam, steep phase.**—The surface soil and subsoil of the steep phase of Carbo silty clay loam are slightly shallower than those of the typical soil but are similar to them in color, texture, and structure. This soil occupies areas having a slope of 30 to 60 percent. Most of the areas are too steep for the production of crops.

Only one-half of a square mile is mapped, chiefly in the eastern part of the county south of Stone Mountain, south of House and Barn Mountain, southwest of Beartown Mountain, and northwest of Rockdell.

With few exceptions, all areas of the soil are in pasture. Bluegrass, crabgrass, and white clover are the main pasture plants. Broomsedge, hawkweed, hairy spurge, wild strawberry, horsemint, mountain-mint, thistle, and peppergrass grow in many pastures. In the few small forested areas the trees are mainly various oaks, red-cedar, black locust, black gum, and black walnut.

**Frederick-Elliber stony silt loams.**—Because of the presence of rock outcrops, this soil complex is almost everywhere unsuitable for cultivated crops. The outcrops of limestone bedrock cover about 15 to 35 percent of the land area. They range from 2 to 5 feet in diameter and protrude above the surface from a few inches to about 3 feet. In some places the outcrops are close together, and in others they are as much as 25 feet apart. Here and there among the rocks are small areas of 1 or 2 acres each in which rocks are not present or are so few that cultivated crops could be grown.

The soil present among the rock outcrops resembles some of the rock-free soils mapped in the county, but the presence of the rocks necessitates a separation that distinguishes this stony soil complex from the rock-free soils. The soils of this complex are variable in color, texture, and structure of the surface soil and subsoil, and in many places they resemble the soils nearby.

In some areas the surface soil is light-brown or grayish-brown silt loam, and the subsoil varies from reddish-yellow friable silt clay to red heavy brittle clay, or yellowish-brown or reddish-yellow slightly plastic and tough silt clay. In other areas the surface soil is light gray or grayish yellow and is underlain by a light-yellow friable silt clay subsoil. In still others the surface soil is light-brown or grayish-brown friable silt loam underlain by a yellowish-brown friable silt clay loam subsoil. Many areas of these variations have a large quantity of chert fragments, ranging from 1/4 to 2 inches in diameter, strewn over the surface or embedded in the surface soil. In a few places the surface soil consists of light-brown or grayish-brown fine sandy loam over a yellowish-brown friable fine sandy clay subsoil. In still other areas the surface soil consists of brown, dark-brown, or almost black silt loam or loam over a yellowish-brown, brownish-yellow, brown, or reddish-brown friable silty clay subsoil.

The surface soils of these many variations range from about 6 to 10 inches in thickness and the subsoils from about 24 to 30 inches.
The land is moderately sloping and rolling, and the slope ranges from 8 to 15 percent. As the many rocks present prevent practically all of this land from being cultivated, the best use for it seems to be for pasture. It furnishes fair pasture.

The total area of this soil complex is only one-half of a square mile. Areas occur chiefly in the eastern part of the county in the vicinity of Old Rosedale; in the southeastern part near Bascomb School and southeast of Elk Garden School; and in the southwestern part southwest of Creswell and Masons Store.

**Frederick-Elliber stony silt loams, steep phases.**—This soil complex is similar to Frederick-Elliber stony silt loam and, like that soil complex, is characterized by rock outcrops, but it differs in that the land has a steeper slope—15 to 60 percent—and shallower soil layers in places.

About 18.7 square miles of this soil complex is mapped. It occurs chiefly within a belt that extends northeastward from Point Truth and terminates on the Russell-Tazewell County line between the Little and Clinch Rivers. Another belt, roughly parallel to the one just mentioned, extends from a point northeast of Hamlin past Flatwoods and Swords Creek to McGlothlin School. Several areas are south of Mocassin Ridge, southeast of Priest Mountain, and on either side of Indian Creek.

Owing to the many rock outcrops and to the hilly and steep relief, the best use for this soil complex is for pasture. About 5 or 6 acres of the land furnishes enough pasturage for one 1,000-pound steer.

**Bland stony silty clay loam.**—Bland stony silty clay loam has a 6- to 8-inch surface soil of purplish-brown or grayish-brown heavy silty clay loam. The subsoil is dark purplish-brown or purplish-red heavy fairly plastic silty clay, which continues to a depth of about 24 inches. Beneath the subsoil is dark purplish-brown friable smooth silty clay loam. In places the surface soil consists of yellowish-brown, dark-gray, gray, or grayish-brown silty clay loam, 6 or 8 inches thick, and the subsoil is brownish-yellow, gray, or mottled yellow and gray plastic silty clay to a depth of about 20 to 24 inches, where it passes into more friable materials or almost white soft decomposed limestone. Outcrops of purple and gray limestone are numerous. They occupy about 15 to 40 percent of the land area. They range from about 2 to 3 feet in diameter and jut from 1 to 3 feet above the surface of the ground. The presence of these outcrops prevents the use of the land for cultivated crops.

The aggregate area of this stony land is about 9.6 square miles. The range in slope is from about 3 to 30 percent, but slightly more than half of the land has a slope between 15 and 30 percent.

The largest areas of this soil are in the eastern part of the county near Clifton, northwest of Belfast Mills Church, north and south of Repass, and east and south of Belfast Mills; in the southwestern part east and southeast of Elk Garden; and in the central part around Lebanon.

Practically all of the soil is in pasture. Bluegrass is the main pasture plant, but orchard grass, broomedge, wild carrot, and wild rhubarb grow in some places. Black walnut, black locust, red maple,
and black oak trees grow here and there in the pastures, and some small areas are forested with such trees. Redcedar grows near the rock outcrops in some pastures. About 3 or 4 acres affords enough pasturage for one 1,000-pound steer.

**Bland stony silty clay loam, steep phase.**—This soil includes the steeper areas of Bland stony silty clay loam. Outcrops of limestone occupy about 15 to 40 percent of the land area. Both the surface soil and the subsoil resemble the corresponding layers of Bland stony silty clay loam, although in many places, particularly on the steepest slopes, the soil layers are not so thick.

This soil covers a total area of about 9.6 square miles. It occurs in an almost continuous belt north of Clinch Mountain from the southwestern part of the county to a point southeast of Hansonville. Fairly large areas are around Rockdell; smaller areas lie south of the Clinch and Little Rivers between Miller View Church and Barrett School, and areas are in other parts of the county.

Because of the many rock outcrops and the steep slope this soil is used largely as pasture land, which produces fairly good grazing. Bluegrass is the main pasture plant, but orchard grass, broomedge, wild carrot, and wild rhubarb grow in places in some of the pastures. Some areas are forested with black locust, black walnut, red maple, and black oak. A scattered growth of these trees and of redcedar has sprung up in many of the pastures.

About 3½ to 4½ acres of this stony land provides sufficient pasturage for one 1,000-pound steer.

**Rolling stony land (limestone material).**—Land of this classification includes land in which outcrops of limestone are much more numerous than in Hagerstown stony silty clay loam, Frederick-Elliber stony silt loams, or Bland stony silty clay loam. Rock outcrops on this rolling stony land occupy about 40 to 90 percent of the surface. The soil between the rocks is variable in color, texture, structure, and depth. It consists of limestone material in various stages of soil formation. This rolling stony land ranges from undulating and rolling to hilly, and the slope generally ranges from about 8 to 30 percent. Because of the presence of numerous rock outcrops, the land is unfit for growing cultivated crops, although some small areas having but few rock outcrops could be used for the production of field crops.

Pasture is the more extensive use made of this land. Some areas support a forest growth of black locust, black walnut, different oaks, and red maple. These trees grow here and there in the pastures. The pasture grasses are mainly bluegrass and crabgrass, but white clover grows in some places. Other small plants, such as white aster, yarrow, cornberry, wild carrot, stickweed, thistle, oxeye daisy, sour grass, foxtail, narrow-leaved plantain, honeysuckle, peppergrass, milkweed, wild lettuce, and smilax, grow in the pastures.

The many rock outcrops on the surface reduce the grazing area considerably, but the soil between the rocks nearly everywhere supports a fairly thick stand of grass. About 4 or 5 acres of this soil affords enough pasturage for one 1,000-pound steer. Those areas having a slope steeper than 15 percent probably are better suited to forest than to pasture.
This land covers 14.3 square miles, or 3.0 percent of the area of the county. The greater part of the land is hilly; the rest is rolling and undulating.

This stony land is widely distributed. The principal areas are in the eastern part of the county south of Clifton; in the southeastern part, near Elk Garden and Rockdell and southwest of Miller View Church; and in the western part, north of Copper Creek from Point Truth to a point northwest of Dickensonville.

Hayter stony loam.—The 8- to 12-inch surface soil of Hayter stony loam consists of brown or dark-brown mellow loam or silt loam. When dry the surface soil is light brown and in places has a purple cast. The subsoil is light-brown, yellowish-brown, brown, or faintly purplish brown friable slightly plastic silty clay loam or silty clay to a depth of about 24 to 30 inches, where it grades into light-brown or brownish-yellow friable silty clay loam containing a few purple and ochery yellow soft decomposed shale particles. In some places friable decayed sandstone particles are mixed with the material. Black mineral specks appear in the subsoil and in the surface soil in some places. Many angular and subangular fragments of brown sandstone, 6 to 10 inches in diameter, in some places as much as 20 inches in diameter, are strewn over the surface and embedded in the soil. Boulders, 3 to 6 feet in diameter, are scattered here and there on the surface.

The material for this soil is derived from various sources. It consists largely of many fragments of sandstone and quartzite that have moved down the mountainsides and have accumulated in beds on lower slopes and on valley floors (pl. 7, B). Intermixed with these fragments are finer soil materials that also have moved downward from slopes nearby. Some of these materials were derived from soils underlain by noncalcareous sandstone and shale and some from soils underlain by limestone. This mixture of rock fragments and soil material overlies noncalcareous shale and sandstone in some places and limestone in other places. The thickness of the mixture ranges from a few feet to about 10 feet.

Hayter stony loam has an aggregate area of about 2.8 square miles. It occurs chiefly north of Clinch Mountain Spur, north of Beartown Mountain, especially near Denniston School; north of Rich Mountain, especially near Sneed's Chapel; and in scattered areas north of Clinch Mountain, from this point southwestward.

Areas of Hayter stony loam are undulating, gently rolling, or moderately sloping. The slope ranges from about 3 to 15 percent. Both surface drainage and internal drainage are good, although in some places internal drainage is rather rapid. The soil has been altered very little by erosion. It is medium acid in reaction.

Because of the presence of a large number of stones, the soil is less desirable for cultivated crops than Hayter loam, which is practically free of stones. A few small areas of this stony land are used for the production of corn, yields of which are lower than on Hayter loam. The most extensive use of the soil is for pasture. About 3½ acres affords grazing for one 1,000-pound steer. Bluegrass and crabgrass are the important pasture plants. Broomsedge, foxtail, yarrow, thistle, pigweed, sour grass, nettle, aster, sage, life everlasting, poke-
berry, and ground-ivy also grow in the pastures. In the forested areas the trees include red oak, black locust, hickory, red maple, black gum, tuliptree, black walnut, spicewood, buckeye, basswood, pitch pine, Virginia pine, cucumbertree, papaw, birch, sugar maple, and butternut (white walnut). Dead chestnut trees remain among other trees in some places.

Hayter stony loam, hill phase.—The hill phase of Hayter stony loam includes the steeper areas of Hayter stony loam, which have a slope of 15 to 30 percent or more. The soil is similar to typical Hayter stony loam in color, texture, structure, and number of rock fragments present, but it differs from that soil in that on some of the steeper slopes it has a thinner surface soil. In relief it ranges from fairly steep to steep.

The total area of this stony soil is about 8.4 square miles. It is associated with the less extensive typical soil and in addition occurs north of House and Barn Mountain.

Both surface drainage and internal drainage are good. Although runoff from the steepest slopes is rather rapid in places, it has not caused serious washing of the land.

As the land is rather steep and stony, only a very little of it is planted to cultivated crops. A large part is in pasture, and 4 or 5 acres is required to supply pasturage for one 1,000-pound steer. Bluegrass and crabgrass are the main pasture plants. Foxtail, yarrow, thistle, pigweed, sour grass, nettle, aster, life everlasting, sage, pokeweed, and ground-ivy also grow in many pastures.

The trees in the forested areas are of about the same species as those growing on Hayter stony loam. The steepest areas of this soil probably are better suited to forest than to pasture.

Jefferson stony fine sandy loam.—The 15- to 18-inch surface soil of this soil is light-yellow, grayish-yellow, or brownish-yellow friable fine sandy loam. In forested areas the topmost 3 or 4 inches of the surface soil is dark-gray or grayish-brown light fine sandy loam. The dark color is due to the presence of organic matter. The subsoil is yellow, slightly brownish yellow, or reddish-yellow friable fine sandy clay, which grades at a depth of about 30 inches into crumbly reddish-yellow and brownish-yellow fine sandy clay. Angular and subangular sandstone fragments, 3 to 8 inches in diameter, are scattered over the surface and embedded in the soil. These rock fragments are so numerous that they make the land distinctly stony.

This soil has developed over beds of rock waste of colluvial origin, consisting of angular and subangular fragments of sandstone. The broken rocks have rolled down from mountainsides and have accumulated on the lower slopes or have spread out on the valley uplands in beds ranging from a few to many feet in thickness. Fine soil materials became mixed with the many rock fragments as they accumulated. The soil is formed from the weathered material of these colluvial deposits. The sandstone fragments are strewn over the surface and embedded in the soil layers.

The total area of Jefferson stony fine sandy loam is less than 1 square mile. Areas of this soil are in the eastern part of the county south of Stone Mountain, near Belfast Mills, and southeast of Rosedale, and in the south-central part in the vicinity of Green Valley Church.
Areas of Jefferson stony fine sandy loam are undulating, gently rolling, or moderately sloping. The slope ranges from 8 to 15 percent, although in most places it is between 8 and 15 percent. Both external and internal drainage are good. In places erosion has carried away small quantities of surface soil.

Owing to the stoniness of the soil, only a few small areas are used for crops. Yields are somewhat lower than on Jefferson fine sandy loam. The soil does not produce good pasturage. From 5 to 7 acres are required to furnish enough pasturage for one 1,000-pound steer.

**Jefferson stony fine sandy loam, hill phase.**—The hill phase of Jefferson stony fine sandy loam comprises areas having a slope of 15 to 30 or more percent. The surface soil and the subsoil have about the same color, texture, structure, and content of stones as the corresponding layers of the typical soil, but on the steeper slopes they are not everywhere so thick.

The total area of this soil is about 7 square miles. It occurs chiefly in the eastern part of the county north and south of House and Barn Mountain, north of Clinch Mountain Spur, around Beartown Mountain, and north of Clinch Mountain, from the central part southwestward.

Both external and internal drainage are good. Because of the rather steep slope, the runoff is rather rapid in places and has removed a small part of the surface soil. In places a few shallow gullies have formed.

Because of the presence of many stones and the rather steep slope, this soil is less desirable for the production of crops than Jefferson stony fine sandy loam. A few small areas of the soil are planted to crops, but the yields are low. For the most part the soil is used as pasture land.

About one-half of a square mile of this soil occurs on steep slopes ranging from about 30 to 60 percent. This steep land probably is better suited to forest than to pasture.

**Melvin silty clay loam.**—The 6- to 8-inch surface soil of Melvin silty clay loam consists of light-gray or gray somewhat plastic silty clay loam or heavy silt loam that in places is spotted with dark brown or rust brown. When dry, much of the surface soil is very light gray or almost white. The subsoil is light-gray plastic silty clay faintly spotted with brown. At a depth of about 24 inches it passes into light-gray or gray heavy very plastic silty clay containing rust-brown spots that become larger and more numerous as depth of the soil increases. At a depth of about 32 to 35 inches small angular pieces of chert and in places particles of sand are mixed with the clay. As mapped the soil includes some areas that have an 8- to 10-inch dark-gray surface soil.

This soil occupies poorly drained first bottoms along some of the streams. The soil material consists of fine soil particles that have been washed from slopes on the uplands underlain by limestone and deposited by running water near the streams.

About 4.3 square miles of this soil is mapped. Narrow strips border many of the smaller streams throughout the county. One of the largest bodies is along Sinking Creek.

The surface of Melvin silty clay loam is almost level to moderately sloping. Drainage is poor in both surface soil and subsoil. The
soil is used mostly as pasture land. Areas that have been drained produce good yields of corn and hay. The soil is well suited to pasture in both dry and wet seasons. From 2 to 4 acres furnish enough pasturage for one 1,000-pound steer.

A few areas have been reclaimed by drainage. On soil that has been drained by ditches, corn yields 40 to 50 bushels an acre without the use of fertilizer; and on soil drained by tile it yields 50 to 60 bushels an acre when the land is fertilized. Oats, which are cut for hay, make an excellent stand on fertilized land, and clover and timothy give good yields of hay. On tile-drained land a rotation of corn, oats, and timothy and clover mixed is followed.

**Atkins fine sandy loam.**—The 6-inch surface soil of this soil is gray or dark-gray slightly plastic fine sandy loam containing small spots of yellow or rust brown. The subsoil consists of gray or mottled gray and brown heavy plastic fine sandy clay or silty clay that becomes somewhat heavier at a depth of about 28 inches. Small areas in which the surface soil is silty clay loam are included in mapping. The surface soil in such areas is much heavier than the surface soil of the typical fine sandy loam.

This soil has developed from sand, silt, and clay that has been washed from slopes of the uplands underlain mainly by noncalcaceous sandstone and shale and has been deposited in narrow strips near streams by running water. The land is nearly level or slightly sloping. Because of the comparative flatness of the land and the rather heavy subsoil, drainage is slow throughout. Only a small part of the soil is used for crops. It is used mostly as pasture land, and because of its poorly drained condition this is probably its best use. If thoroughly drained by ditches and limed, the soil possibly would give fair yields of corn and hay. The soil provides a fair to low amount of pasturage.

The total area of Atkins fine sandy loam is 1.5 square miles. This soil occurs in the northeastern part of the county, along the Clinch River and some of its tributaries and along Cedar Creek near Rosedale; in the southeastern part, near Tumbling Creek; and in the northwestern part, along Dumps Creek and its branches, along the Clinch River west of Carterton, and along Lick Creek and its branches.

**Alluvial soils, undifferentiated.**—Alluvial soils, undifferentiated, include areas in narrow first bottoms in which the soils were not differentiated one from another because of extreme variability of texture, structure, consistence, drainage condition, and other characteristics within short distances. Included are soils of the Pope, Philo, Atkins, Lindside, and Melvin series. Textures range from fine sandy loam to silt loam in the surface soil and fine sandy loam to silty clay loam in the subsoil. Drainage is fair to poor. The soils are modified in many places by chert or sandstone fragments on the surface and in the soil.

This mixture of soils has formed from materials that have been derived from slopes underlain by noncalcaceous sandstone and shale or by limestone and have been laid down by running water near streams. In some places soil materials have been washed from nearby slopes and deposited directly on the soil.

Most of the land furnishes fair pasture. The main pasture plants are bluegrass and crabgrass. Bulrush, mint, aster, and narrow-leaved
plantain grow among these grasses. Willow, alder, and a few sycamore are the more common trees.

This land is nearly level or slightly undulating. The total area is about 3.3 square miles. Bodies are widely distributed throughout all parts of the county. Some of the largest ones border tributaries of the Clinch River in the northwestern part.

Included with alluvial soils, undifferentiated, as mapped, are small areas of riverwash. Riverwash consists of light-brown fine or medium sand containing many sandstone and quartzite pebbles and many larger fragments of water-worn sandstone. In some places smooth water-worn pieces of limestone are present in the soil. Sand bars and low hummocks are present in some places. The sand, pebbles, gravel, and stones are so mixed that the soil has no definite profile or textural arrangement. In the coal-field section of the county some mine waste, consisting of fine and coarse pieces of coal, are mixed with the soil.

Sycamore and willow are the main trees growing on the included areas of riverwash. Some coarse grasses and some weeds appear here and there. The land is not suitable for cultivated crops or for pasture, and its best use seems to be for forest.

FIFTH-CLASS SOILS

The Fifth-class soils include Hagerstown stony silty clay loam, steep phase; Clarksville cherty fine sandy loam, hilly phase; Clarksville cherty fine sandy loam, steep phase; Westmoreland silt loam, very steep phase; Westmoreland silty clay loam, very steep phase; Upshur-Litz silt loams, steep phases; Litz shaly silt loam; Litz shaly silt loam, hilly phase; Upshur-Litz shaly silt loams; Upshur-Litz shaly silt loams, steep phases; rough stony land (limestone material); Wellston loam, hilly phase; Muskingum loam; Muskingum loam, very steep phase; Muskingum stony loam; Muskingum very fine sandy loam; Muskingum very fine sandy loam, hilly phase; Muskingum stony very fine sandy loam; Montevallo shaly silt loam; Lehew very fine sandy loam; rough stony land (Muskingum soil material); rock outcrop; and mine dumps.

The aggregate area of these soils is about 212 square miles. The various soils are placed in this class because of the steepness of the slope, the roughness of the relief, the presence of many small sandstone fragments, boulders, or rock outcrops, or the naturally impoverished condition of the soil. These conditions render the soils largely unfit for cultivated crops or for pasture. In some places small areas of some of the soils are used for crops, even though the yields are low, on farms owned by people who work in the nearby coal mines (pl. 8).

Small areas are in pasture, but the pasture is poor in comparison with that on the more favorable soils of the county. The Muskingum and Lehew soils are particularly low in the quantity of pasture afforded. The Hagerstown, Clarksville, and Westmoreland soils, and rough stony land (limestone material) in this group are distributed mainly in the lowland belt. The Wellston, Muskingum, and Lehew soils, and rough stony land (Muskingum soil material) are on mountain slopes and ridges.

A large part of the area of these soils ranges from about 60 to 80 percent or somewhat more in slope. Large areas of the soils support
a forest growth from which most of the marketable timber has been removed. If cleared of forest the soils would be subject to severe erosion, and the cost of maintaining them would hardly be justified by the yields made by field crops or pasture.

Hagerstown stony silty clay loam, steep phase, contains a large number of small limestone outcrops, which occupy about 15 to 40 percent of the land area. The Clarksville soils in this group have a large quantity of chert fragments on the surface and in the soil layers. These soils are considerably leached, and their productivity is difficult to maintain. Westmoreland silt loam, very steep phase, and Westmoreland silty clay loam, very steep phase, have slopes of 60 percent or considerably more and, although some areas are used as pasture land, most of the areas seem to be best suited to forest. Upshur-Litz silt loams, steep phases, include shallow soils that become severely eroded when cleared of forest. Litz shaly silt loam and Litz shaly silt loam, hilly phase, are in few places more than 12 inches deep, and small shale fragments are on the surface and in the soil. The soil is underlain by a rock formation consisting of shale and limestone, mainly the former. Rough stony land (limestone material) has steep slopes, ranging from about 30 to 60 percent or more. The land is characterized by a large number of small limestone outcrops, which occupy from 40 to 90 percent of the area. The soil among the rocks is variable in color, texture, structure, and depth.

The Wellston soil and the Muskingum soils have yellowish-brown, brownish-yellow, or grayish-yellow surface soils. The subsoils are brownish-yellow, light-brown, or yellowish-brown friable loam, fine sandy clay, or silty clay. Angular fragments of sandstone are numerous on the surface and throughout the soil mass of Muskingum stony loam and Muskingum stony very fine sandy loam. Montevallo shaly silt loam is comparatively shallow, averaging about 10 inches in depth, although in some places the depth varies. Small shale fragments are present on the surface and in the soil, and noncalcareous shale underlies the soil. Leheu very fine sandy loam has a brown or purplish-brown surface soil. The subsoil consists of purplish-brown or purplish-red friable very fine sandy clay. This soil is developed from the weathered material of purple noncalcareous shale and sandstone. Rough stony land (Muskingum soil material) comprises the Muskingum soils on which are many small loose sandstone fragments, boulders, or sandstone outcrops. The relief in many places is rough and broken, and the soil is comparatively shallow. In some places only the surface soil has developed, and bedrock lies immediately beneath it.

Rock outcrop includes bare exposures of sandstone. It has no agricultural value, although stunted trees and bushes grow in places in crevices in the rocks and on ledges where a small quantity of soil material has accumulated. Mine dumps likewise have no agricultural value.

Hagerstown stony silty clay loam, steep phase.—This soil differs from typical Hagerstown stony silty clay loam mainly in the greater steepness of the slope, and in some places the soil is not so deep.

The steep slopes and numerous rock outcrops prevent cultivation of almost all of this soil. Light-weight cattle and sheep graze on the steep slopes of some areas, but probably the soil is best suited to forest.
The trees are principally black locust, black walnut, redcedar, and oaks.

This steep stony soil occupies a total area of 8 square miles. It occurs chiefly throughout a belt extending from a point southwest of Castlewood northeastward to Mclothlin School. Bodies are south and southwest of Lebanon.

Clarksville cherty fine sandy loam, hilly phase.—The hilly phase of Clarksville cherty fine sandy loam differs from typical Clarksville cherty fine sandy loam mainly in relief, having a 15- to 30-percent slope in contrast with the 5- to 15-percent slope of the typical soil. Because of the steeper relief, this soil is not so good as typical Clarksville cherty fine sandy loam for the cultivation of crops.

About 4.3 square miles of this soil is mapped, chiefly south of Moccasin Ridge and Copper Ridge.

This cherty soil contains only a very small quantity of organic matter. Drainage is good throughout. The cleared areas have lost considerable soil by erosion. A small part of the soil is used for growing corn, wheat, other small grains, hay, and tobacco. Yields of these crops are lower than those of the same crops on the typical soil, although the fertilizer treatment for corn, wheat, and tobacco is the same for both soils. This soil furnishes poor grazing.

The main use of the land is for forest. In the forested areas several species of oak, tuliptree, dogwood, red maple, hickory, sourwood, and pine trees grow. Dead chestnut trees still stand in some places in the forests.

Clarksville cherty fine sandy loam, steep phase.—This soil occupies the steepest areas of Clarksville cherty fine sandy loam, having slopes of 30 to 60 or more percent. The color, texture, structure, and chert content of the surface soil and subsoil are about the same as those of the typical soil, although in some places the soil layers are not quite so thick. The steep slopes are unfavorable for the growing of cultivated crops.

The soil is low in natural fertility. When the land is cleared of forest it is subject to severe erosion. A large part of the soil is forested. The trees include white oak and other oaks, tuliptree, dogwood, red maple, hickory, sourwood, and pine.

The aggregate area of this soil is 3.9 square miles. It occurs chiefly in association with the soil of the hilly phase along Copper Ridge, along Priest Mountain, and between the Little and Clinch Rivers.

Westmoreland silt loam, very steep phase.—This soil is similar to typical Westmoreland silt loam, except that the slopes are much steeper and the surface soil in many places is not quite so thick. In some of the steepest areas the subsoil is not so thick or so well developed as in the typical soil.

The soil is best suited to forest, although some areas are used as pasture land. The pastures consist principally of bluegrass and crabgrass. Light-weight cattle and sheep graze on the steep slopes. Trees in the forested areas include black oak, hickory, black locust, tuliptree, wild cherry, dogwood, red maple, and redcedar.

Some areas contain many outcrops of bedrock and are indicated on the map by symbols.

Westmoreland silt loam, very steep phase, covers a total area of 6.5 square miles, in many places associated with the typical soil.
Westmoreland silty clay loam, very steep phase.—This soil occupies steeper areas than typical Westmoreland silty clay loam. It has slopes of 60 to 80 or more percent. The soil characteristics are practically the same as in the typical soil, except that in some places the surface soil and subsoil are not so thick.

Outcrops of limestone bedrock appear in some areas, which are indicated on the map by symbols. These areas are better suited to forest than to pasture.

About 3.7 square miles of this soil is mapped. It occurs in the eastern part of the county between the northeast side of House and Barn Mountain and the Russell-Tazewell County line, on the north slope of Stone Mountain; west, southwest, and northeast of the Doubles on River Mountain, and southwest and west of House and Barn Mountain; in the southeastern part on the north slope of Clinch Mountain Spur, near the Russell-Washington County line, northwest of Price Chapel; and in the southern part on the north slope of Clinch Mountain, south of Little Moccasin Gap, and south of Willow Spring.

A fairly large part of the soil is used as pasture land. The soil supports a good stand of grass, mainly bluegrass and crabgrass. The grass cover apparently protects the soil from erosion, as only small eroded areas are evident. Light-weight cattle and sheep graze on the pastures.

Upshur-Litz silt loams, steep phases.—Areas of Upshur-Litz silt loams having a slope of 30 to 60 percent or steeper are designated as steep phases; whereas typical areas of Upshur-Litz silt loams have slopes of 8 to 30 percent. Except in depth and slope, the soils of these two soil complexes are similar.

This complex is underlain by soft decomposed shale at a depth of 8 to 12 inches. In many places the decomposed shale is just beneath the surface soil, and in others it is exposed. Outcrops of limestone bedrock appear in places, and these are indicated on the soil map by symbols.

Upshur-Litz silt loams, steep phases, cover a total area of about 12.5 square miles. This soil complex is distributed throughout a southwest-northeast belt roughly parallel to the Clinch River, but the largest areas are in the north-central part of the county in association with areas of Westmoreland silt loam.

Practically all of this steep land is in forest, and the trees are of the same species as those growing on Upshur-Litz silt loams. When cleared of forest, the land is subject to severe erosion; therefore it is better suited to forest.

Litz shaly silt loam.—The 6- to 8-inch surface soil of Litz shaly silt loam is light-brown or grayish-brown silt loam mixed with various quantities of thin platy noncalcareous shale fragments. The subsoil is light-brown friable silty clay, which continues to a depth of about 12 inches. This layer is underlain by partly decomposed shale. In some places this soil consists merely of a mixture of a small quantity of soil material and small thin pieces of shale.

Litz shaly silt loam is developed from the decayed upper part of a rock formation consisting mainly of shale and containing a few layers of limestone. Unlike the rock formations that give rise to soils of the Westmoreland series, this formation consists almost entirely
of shale. Only a very small proportion of limestone is present. Because of the character of the underlying rock and the steepness of the slope, the soil has never fully developed. Erosion is active on the steep slopes, and in many places it has carried away the soil almost as fast as it has formed.

Outcrops of bedrock occur in many places and are indicated on the soil map by symbols.

In some places the soil is underlain by a soft somewhat green shale, which becomes yellow on weathering. In most places the shale gives way to a blue-banded limestone layer, which in some places is 100 feet thick. In some places the soil is underlain by green, yellow, and purple shale interbedded with some gray limestone and some hard brown limestone. The soil has formed from the soft weathered material of these rock formations.

The aggregate area of Litz shaly silt loam is about 9 square miles. Areas of the soil occur throughout a belt roughly parallel to the Clinch River but lying mainly south of it. Other areas lie along Moccasin Ridge and River Mountain.

Surface drainage is good, and on unprotected slopes it is excessive. Because the shale bedrock is near the surface, internal drainage is poor. Erosion has removed a part or all of the surface soil in some places, and gullies have formed.

This shaly soil apparently contains very little organic matter. It is very acid in reaction. Rather heavy applications of complete fertilizer or superphosphate and of lime are necessary to obtain fair crops.

Nearly all of the soil is in forest. The trees include black oak, hickory, blackjack oak, redcedar, black walnut, mulberry, black locust, sassafras, dogwood, red maple, wild cherry, tuliptree, cucumber-tree, and sycamore. Native plants growing in open country include crabgrass, broom-sedge, smilax, ragweed, sheep sorrel, hawkweed, sour grass, and poverty oatgrass.

A small part of the soil is in pasture, but it furnishes poor grazing. On some small areas corn, wheat, and tobacco are the leading crops. Corn yields about 10 bushels an acre and wheat 2 to 4 bushels. Tobacco produces 1,000 pounds an acre when the land is treated with 800 pounds of 3–10–6 fertilizer and a large quantity of stable manure.

Litz shaly silt loam, hilly phase.—The 6- to 8-inch surface soil of this soil consists of light-brown or grayish-brown silt loam containing small thin noncalcareous shale fragments in various quantities. Many platy shale particles are strewn over the surface in places. The subsoil is light-brown fairly friable silty clay to a depth of about 12 to 15 inches, where it is underlain by decomposing shale. In places very little soil has developed, and in others the soil is merely a mixture of soil material and small thin shale fragments. The rock formation that gives rise to this soil is composed of shale and a few layers of limestone.

Many outcrops of bedrock are in some areas and are indicated on the soil map by symbols.

This shaly soil occupies rolling or hilly country, where the slope ranges from about 8 to 30 percent. External drainage is good, but internal drainage is slow. Erosion, of both the sheet and gully types,
is evident in some places. The soil is very low in organic-matter content and is very acid in reaction.

Much of the land is forested. The trees consist of black oak, blackjack oak, hickory, cedar, black walnut, mulberry, dogwood, red maple, black locust, wild cherry, sassafras, tuliptree, cucumber-tree, and sycamore. The vegetation also includes crabgrass, broom-sedge, milax, sheep sorrel, hawkweed, and poverty oatgrass. Some areas are used as pasture land.

A small part of the land is planted to corn, wheat, and tobacco. Corn yields about 10 bushels and wheat about 4 bushels an acre. Tobacco produces 1,000 pounds under good management including a heavy application of stable manure and 800 pounds of 3–10–6 fertilizer. Oats yield about 15 bushels an acre and are usually fertilized with 300 to 400 pounds of 20 percent superphosphate. Sweetpotatoes, tomatoes, cabbage, and beans give fair returns.

Only one-half of a square mile is mapped. Some of the largest areas are in the central part of the county northwest of Copper Ridge School and in the western part between Castlewood and Gose School.

**Upshur-Litz shaly silt loams.—** Upshur-Litz shaly silt loams are two soils occurring side by side in areas too small to show separately on the soil map, and as a result they are classified as a soil complex. The Upshur soil is purplish red and the Litz soil is light brown. The 4- to 6-inch surficial soil of the Upshur soil consists of light purplish-brown, purplish-brown, or purplish-red friable silt loam. The subsoil is purplish-brown or purplish-red friable smooth silty clay to a depth of 10 to 15 inches, where it grades into mixed brown, dark purplish-brown, and dark purplish-red friable silty clay consisting mainly of soft decomposed shale. The Litz soil has a 4- to 6-inch light-brown friable silt loam surface soil. The subsoil is brown or yellowish-brown friable silty clay to a depth of 10 to 15 inches. It is underlain by soft brownish-yellow decomposed shale. On the surface and throughout these two soils are many small thin light-green, yellowish-brown, and purplish-brown shale particles that give the soil a shaly appearance. In some places no subsoil has developed and the surface soil rests directly on soft decomposed shale; in other places no soil has developed and the decomposed shale appears at the surface. Limestone outcrops are present in some places and are indicated on the soil map by symbols.

These shaly soils have formed from the weathered products of a rock formation consisting mainly of green, yellow, and purple shale, in which are bedded some layers of gray limestone and hard brown limestone.

Less than 1 square mile of this soil complex is mapped. One of the largest areas is northwest of Castlewood. The slope is between 3 and 15 percent in areas southwest of Dickensonville and Cleveland. In general, the land is rolling and hilly. Surface drainage is rather rapid, but internal drainage is slow because of the shallowness of the soil over bedrock. Erosion is active; sheet erosion has damaged some areas, and gullies have formed in places. The soil contains little organic matter and is acid in reaction.

A small part of the soil is cleared and used as pasture land. It furnishes very poor grazing, and 8 to 10 acres are necessary to support one 1,000-pound steer.
Small vegetation growing on this soil includes crabgrass, broom-sedge, smilax, ragweed, sheep sorrel, hawkweed, sourgrass, and poverty outgrass.

Nearly all of the land is forested. The trees are mainly black oak, hickory, redcedar, black walnut, mulberry, black locust, sassa-fras, dogwood, red maple, wild cherry, tuliptree, cucumbertree, and sycamore. The soil is not well suited to cultivated crops or pasture because of its shallowness, its low productivity, the presence of many small shale fragments, the rather steep slope in many places, and the marked tendency to erode.

Upshur-Litz shaly silt loams, steep phases.—Areas of Upshur-Litz shaly silt loams having slopes of 30 to 60 percent or more are designated as a complex of steep phases of the Upshur and Litz soils. Except for slighter depth and steeper slope, this soil complex resembles the typical one. Because of steep slope, shallowness of the soils, and severe action of erosion on cleared areas, this land is best suited for forest.

Upshur-Litz shaly silt loams, steep phases, occupy 14.6 square miles. The complex is distributed in the same localities as Upshur-Litz shaly silt loams and Litz shaly silt loam. Practically all of the land is in forest, and the trees include about the same species as grow on Upshur-Litz shaly silt loams.

Rough stony land (limestone material).—This classification includes the steepest areas, most broken areas, and gullied areas (pl. 9, A) of the limestone stony lands, ranging in slope from 30 to 60 or more percent. Limestone outcrops are numerous and occupy from 40 to 90 percent of the land surface. The soil in the small areas among the many rock outcrops is variable and consists of limestone soil material in various stages of soil development (pl. 9, B). Included with this land as mapped are areas of Dunmore stony silt loam, steep phase, and Bland stony silty clay loam, steep phase. Although these included soils are not so stony as rough stony land, the slope, which is 60 percent or somewhat more, is so steep that separation of them on the soil map is not warranted.

Because of the number of rock outcrops and the steepness of slope, practically all of this rough stony land remains in forest. A few areas are in pasture but have a low value for grazing.

About 33.7 square miles of this land type is mapped. It is widely distributed along the Clinch River and Mocassin, Copper, and Cedar Creeks. Several areas are around Rockdell.

Wellston loam, hilly phase.—The hilly phase of Wellston loam has practically the same surface soil and subsoil characteristics as typical Wellston loam, but it occupies positions on somewhat steeper slopes.

The total area of Wellston loam, hilly phase, is 2.4 square miles. The soil occurs in the northeastern part of the county, in the north-central part near Rasnake, and in the northwestern part, especially on Flat Top Ridge.

This soil is less favorable for cultivation than the typical soil. Cleared areas have lost much of the surface soil through erosion, and what surface soil remains is much shallower than that of the eroded areas of Wellston loam. This soil is acid in reaction and requires 2,000 to 4,000 pounds an acre of ground limestone to correct the
acidity. Surface drainage is good to excessive, and internal drainage is well established. The soil responds well to treatment with complete fertilizer. A good cropping practice consists of corn followed by grass for 3 years.

The principal use of the cleared soil is for the production of corn, small grain, and pasturage. Corn yields about 20 bushels an acre and is commonly fertilized with 200 pounds of 4-12-4 fertilizer. Wheat yields 4 to 6 bushels an acre. Hay crops make low returns. Sorgo is grown by some farmers, and the yield of sirup is about 100 gallons an acre. Vegetables grown in home gardens do fairly well. Pastures on this soil are poor. Most of the land is in forest, and the trees are the same as those on Muskingum loam.

Muskimgum loam.—The 8- to 10-inch surface soil of Muskingum loam is yellowish-brown mellow loam, which on drying becomes very light brown or light grayish brown. In pastures and in forests the surface layer, to a depth of 2 to 4 inches, is brown or grayish-brown mellow loam, the darker color being due to the presence of organic matter derived from decayed grass or leaves. When the land is cleared and cultivated the organic matter present is soon dissipated and the soil becomes lighter colored. The subsoil is brownish-yellow friable heavy loam or fine sandy clay containing a few brown partly decomposed shale and sandstone particles that can be easily crushed to a soft material having no definite structure. At a depth of 24 to 28 inches the subsoil passes into mingled ochreous-yellow, brown, and dark reddish-brown friable crumbly silty clay loam mixed with soft decomposing fragments of brown sandstone and dark-green shale. Bedrock underlies this material at a depth of 35 to 50 inches. In some places a few angular fragments of sandstone are on the surface.

The parent material consists of soft weathered sandstone and shale that have formed in alternate layers. The sandstone is medium coarse-grained gray thick- or thin-bedded arkosic sandstone. In some places the sandstone of this formation is conglomeratic. In other places a different formation underlies the soil and consists of conglomerate, sandstone, and shale. Coal beds are present in these rock formations.

Muskingum loam is widely distributed in the districts north of the Clinch River, and its aggregate area is about 38.8 square miles, or 8.2 percent of the area of the county.

The soil has slopes of 30 to 60 percent. When cleared of forest and left bare, the soil is subject to serious erosion, both in the loss of surface soil and the formation of gullies. Many drainageways have cut rather deeply into the slopes and in most places cannot be cultivated across. Outcrops of sandstone bedrock appear in places. Internal drainage is good. The soil is low in organic matter. It is acid and requires from 2,000 to 4,000 pounds of ground limestone to the acre. Better results are obtained when the land is treated with a complete fertilizer, but, even with such treatment, yields of crops are comparatively low.

Only a small part of the soil is cleared and used for agriculture. The rest supports a forest growth consisting of various oaks, hickory, ash, dogwood, tuliptree, red maple, butternut, beech, cucumbertree, basswood, hemlock, and black gum. Dead chestnut trees are scattered among the forest trees.
A. Rough gullied land, apparently originally Westmoreland silt loam, which is unsuitable for crop production because of steepness, shallowness, and high susceptibility to erosion. B. Rough stony land (limestone material). Outcrops of limestone are so numerous that they not only prevent the use of the land for crop production but also greatly lower its value for pasture.
A. A herd of purebred Hereford cows and calves on the county farm near Lebanon.
B. A representative flock of sheep, most of which are grade Hampshires.  C. Cattle grazing on Landside silt loam, one of the most productive soils for pasture. The less productive Lodhi and Clarksville soils of strongly sloping areas are in the background.
Corn, wheat, oats, and hay are the principal crops grown. Corn yields about 10 bushels an acre without an application of fertilizer. Under good management it may be expected to produce 15 to 25 bushels. Yields as high as 35 bushels an acre sometimes are obtained on land treated with 400 pounds of 20 percent superphosphate. With the use of manure in a good rotation, wheat yields 4 to 6 bushels, oats 15 to 25 bushels, and sorgo about 100 gallons of sirup. Hay returns low yields. Potatoes and sweetpotatoes yield fairly well. Some farmers practice a rotation of crops, consisting of corn, wheat or oats, and grass for 1 or 2 years. A good practice in the production of crops consists of a crop of corn followed by grass for 3 years. Some areas are in pasture, but the pasturage afforded is comparatively poor, as the carrying capacity is about 6 acres to 1 cow or to 3 or 4 sheep. Common plants growing on cleared areas are crabgrass, orchard grass, lespedeza, sheep fescue, tall redtop, foxtail, narrow-leaved plantain, wild strawberry, aster, life everlasting, smilax, blackberry vines, oxeye daisy, wild carrot, stickweed, broomsedge, horseweed, goldenrod, dandelion, mullein, speedwell, sheep sorrel, and sumac. Because of its steep slope, erodibility, and comparatively low productivity for crops, this soil seems to be best suited to forest.

Muskimgum loam, very steep phase.—This soil differs from Muskimgum loam in that the slopes are much steeper and more broken and the surface soil and subsoil are not everywhere so thick. The soil occupies steep slopes where conditions are not everywhere favorable to the formation of a deep soil.

This soil covers 28.1 square miles, or 6 percent of the total area of the county. It is distributed throughout the northeastern and northwestern parts, in association with the typical soil. Practically all of the land is forested, and the trees include different oaks, dogwood, tuliptree, red maple, beech, cucumbertree, ash, hickory, basswood, and black gum. Dead chestnut trees are scattered through the forests.

Because of its steep slopes and broken relief, the soil is nearly everywhere unsuitable for crops or pasture, and its best use is for forestry.

Muskimgum stony loam.—The 2- or 4-inch surface layer of Muskimgum stony loam in forested areas is brown, grayish-brown, or dark-brown friable loam in which a small quantity of humus is present. Below this layer the surface soil is brownish-yellow or yellowish-brown mellow loam or heavy silt loam. The subsoil, which begins at a depth of about 10 to 12 inches, is brownish-yellow or brown friable loam or heavy fine sandy clay containing a few small brown partly decomposed shale and sandstone fragments. At a depth of 24 to 30 inches the subsoil passes into mixed ocherous-yellow, brown, and dark reddish-brown crumbly silty clay loam also containing partly decayed brown sandstone and dark-green shale fragments. The soil is underlain at a variable depth by alternate beds of sandstone and shale. On the surface and in the soil are many angular sandstone fragments from 4 to 8 inches in diameter. These sandstone fragments are so numerous that they give the soil a stony appearance. Sandstone bedrock outcrops here and there. The soil in some places is shallow, and sandstone and shale bedrock lies at a depth of 24 to 30 inches.
This soil comprises a total area of about 18.3 square miles. The soil is distributed in the northeastern, northern, and northwestern parts of the county, associated with Muskingum loam and Muskingum loam, very steep phase.

Muskingum stony loam occupies hilly, steep, and very steep areas. When cleared of forest the soil is subject to severe erosion unless it is protected by a cover of grass.

Practically all of the land is forested. Some small areas are in pasture, although the carrying capacity is very low—about one-half as much as on Muskingum loam. The forest growth includes scarlet oak, chestnut oak, white ash, hickory, buckeye, basswood, red maple, wild cherry, dogwood, redbud, sassafras, and pitch pine. Dead chestnut trees remain in the forests in places. Because of the number of stones and the unfavorable relief in most places, this soil is better suited to forest than to pasture or to cultivated crops.

**Muskingum very fine sandy loam.**—The 6- to 8-inch surface soil of this soil is light brownish-yellow or light grayish-yellow friable very fine sandy loam. Under forest cover the topmost inch or two of the surface soil is gray or grayish-brown very fine sandy loam in which a small quantity of decayed vegetable material has accumulated. The subsoil is light-brown or yellowish-brown friable crumbly very fine sandy clay to a depth of 18 to 24 inches. Underneath the subsoil the soil material consists of brown, slightly reddish brown, and ochersous-yellow soft friable fine sandy clay mixed with fragments of ochersous-yellow, reddish-brown, and very light gray decomposed sandstone. At a depth of 30 to 35 inches or more the soil material rests on light-brown and yellowish-brown fine-textured sandstone. Fragments of light-gray sandstone, from 4 to 10 inches in diameter, are on the surface and in the soil but not in sufficient quantities to give the soil a stony texture.

Only 64 acres of Muskingum very fine sandy loam is mapped, mainly in the southeastern part of the county near Laurel Bed. This soil occupies positions on slopes that are too steep to be used for cultivated crops. If cleared of forest cover the soil would be subject to severe erosion because of the rapid runoff of rain water.

Forest covers practically all of the soil. The trees include scarlet oak, scrub pine, hickory, chestnut oak, dogwood, sourwood, and tuliptree. Mountain-laurel and huckleberry bushes grow in many places. Nearly all of the best trees have been cut for lumber, and the trees now standing are in various stages of growth. The best use for this soil is for forest.

**Muskingum very fine sandy loam, hilly phase.**—This soil differs from Muskingum very fine sandy loam mainly in relief. In texture, color, and structure of the surface soil and subsoil the soil is similar to the typical soil, but it is not quite so thick. This hilly land occurs mostly where the slope ranges from 15 to 30 percent, although it also includes a few small areas having an 8- to 15-percent slope. Both surface drainage and internal drainage are good, but if cleared of forest the soil would be subject to rather severe erosion unless held in place by a cover of grass. The soil is underlain by sandstone. The fertility is low in comparison with that of the soils underlain by limestone. Most of the soil is forested. The trees consist of scrub pine, scarlet oak, hickory, chestnut oak, dogwood,
sourwood, and tuliptree. Practically all of the merchantable timber has been removed, and the present trees are of different ages.

Only 64 acres of this soil is mapped, mainly near Laurel Bed in association with the typical soil.

**Muskingum stony very fine sandy loam.**—In forested areas the surface layer of this soil to a depth of about 1 inch is gray very fine sandy loam containing a small quantity of organic matter derived from decayed leaves and twigs. Beneath this thin layer the surface soil is composed of light grayish-yellow or light brownish-yellow friable very fine sandy loam to a depth of about 8 inches. The subsoil is light-brown or yellowish-brown friable very fine sandy clay, which passes at a depth of 20 to 24 inches into brown and reddish-brown crumbly fine sandy clay containing ochreous-yellow, reddish-brown, and very light gray soft decomposed fragments of sandstone. Sandstone bedrock underlies this material at a depth of 30 to 35 inches. Strewn over the surface are many fragments of sandstone, 6 to 8 inches in diameter, which give the soil a distinctly stony character. Fragments of sandstone are also embedded in the soil in places. In many places the soil is shallow and bedrock comes within a few inches of the surface soil. In some places no subsoil has developed and the surface soil lies directly on the bedrock.

This soil covers a total area of 5.8 square miles. Most of it is in the southeastern part of the county south of Clinch Mountain Spur and on Clinch Mountain along the Russell-Smyth County line. It also occurs in the northern part near Bradley Gap and northeast of Combs School and in the western part, near Burtons Ford and west of Shannon Tunnel.

The land is hilly, steep, or very steep. Nearly all of it is in forest. The trees include scarlet oak, scrub pine, chestnut oak, hickory, dogwood, sourwood, tuliptree, ash, black gum, black locust, and red maple. Most of the best trees have been cut for timber.

Because of the many stones on the land and the steep slope, very little farming has been done. A few small areas are planted to crops or are in pasture, but crop yields are low and the pastures are poor in comparison with those on the stronger soils.

**Montevallo shaly silt loam.**—The topmost 1/2-inch layer of this soil in forested areas is dark-brown loam containing a considerable proportion of organic matter and a few thin particles of shale. Beneath this layer the surface soil consists of friable brownish-yellow or yellowish-brown silt loam that can be easily crushed to a smooth mass. Mixed with this layer are many small platy fragments of shale.

The subsoil begins at a depth of about 6 inches and consists of brownish-yellow or yellowish-brown friable silty clay or silty clay loam containing many small fragments of shale. At a depth of 10 to 20 inches the subsoil is underlain by shale, most of which is gray, but in some places there is a considerable amount of olive-colored shale mixed with the gray. Brown, yellow, and red shale are also present, but to less extent than the other shales. In some places shale immediately underlies the surface soil.

This soil occurs mainly in the eastern part of the county north of Stone Mountain and in the northwestern part between Weaver Creek Church and a point southwest of South Clinchfield.
The soil occupies rolling, hilly, and steep slopes. External drainage is rapid on slopes unprotected by a cover of grass or forest, and internal drainage is good.

Most of this land is forested. The trees consist of scarlet oak, chestnut oak, dogwood, red maple, white oak, sourwood, and black gum. Dead chestnut trees appear in places. Chinquapin bushes grow here and there. Nearly all of the trees are smaller than those growing on the deeper soils.

The soil is poor cropland and poor pasture land. Even with the use of fertilizer, corn makes very low yields, and where the land is used for pasture the quality of the grass is generally poor. Good crops of hay are obtained from newly cleared fields, which were limed and fertilized when planted to corn and small grain. Corn yields as much as 15 bushels an acre and wheat as much as 10 bushels, on land treated with a heavy application of complete fertilizer. The soil is subject to erosion, and the surface soil is quickly washed off when the land is cleared of forest. The cost of producing crops and the risk run in cultivating this soil are too great to be compensated for by the returns made. None of the steeper slopes should be cleared of forest. About the only spots that can be successfully used for crops are areas of deeper soil that has formed from material collected at the foot of some of the steep hills. In cleared but uncultivated areas the vegetation includes mainly dewberry vines, broomseed, blackberry vines, and sheep sorrel.

Lehew very fine sandy loam.—The 6- to 7-inch surface soil of this soil is brown or purplish-brown friable very fine sandy loam or fine sandy loam. In forested areas the topmost inch or two of the surface soil is slightly darker than the rest of the layer, because of the presence of a small quantity of partly decayed organic matter. The subsoil consists of light purplish-brown or almost purple friable crumbly very fine sandy clay or fine sandy clay, which passes at a depth of 24 to 30 inches into soft decomposed purplish-red sandstone and shale mixed with soft purplish-red fine sandy clay. A few thin pieces of shale and small angular sandstone fragments are on the surface and in the surface soil. Sandstone fragments, 4 to 6 inches in diameter, are on the surface in places, and sandstone bedrock outcrops here and there.

Near Ground Hog Hollow several small areas of somewhat purple soil are included with Lehew very fine sandy loam as mapped. The 3-inch surface layer is light purplish-brown friable fine sandy loam. Many small fragments of purple shale and sandstone, ranging from ½ to 1 inch in diameter, are scattered over the surface. This layer is underlain by purplish-brown silty clay loam containing a small quantity of disintegrated sandstone. At a depth of about 30 inches the subsoil passes into soft mellow silty clay loam containing partly disintegrated fragments of brown sandstone and decomposed purple shale. The material from which this included soil is derived is partly calcareous, and the included areas sustain a slightly better growth of grass than do the areas of Lehew very fine sandy loam that is derived from decayed noncalcareous purple sandstone and shale.

The aggregate area of Lehew very fine sandy loam is 2.2 square miles. Areas of this soil are in the southeastern part of the county near the crest of Clinch Mountain Spur northeast of Mutters Gap,
near Hayters Gap, east of Middle Knob, and near Beartown Mountain about 2 miles southeast of Denniston School; in the northeastern part, near Stone Mountain; in the northern part, near Big A Mountain and northeast of Combs School; in the southwestern part, near the summit of Clinch Mountain; and in the western part near Pine Ridge.

Lehew very fine sandy loam occupies hilly, steep, and very steep areas having slopes of 15 to 60 percent or somewhat more. About one-quarter of the land ranges from 15 to 30 percent in slope, one-half ranges from 30 to 60 percent, and the rest has slopes of 60 percent or considerably more. For the most part the soil is unfavorable for the cultivation of crops. Owing to the steepness of slope, runoff is rapid and carries away the surface soil if the land is not protected by vegetation. In cleared areas the organic-matter content of the soil is low. The soil is very strongly acid in reaction.

Practically all of this land is in forest. The trees are mainly chestnut oak, black locust, cucumber tree, tuliptree, sugar maple, sassafras, hackberry, and wild cherry. The few areas of the soil that are in pasture rank low in value of the pasturage afforded.

Rough stony land (Muskingsum soil material).—The 1- or 2-inch surface layer of this soil is gray or grayish-brown very fine sandy loam or loam. A small quantity of decayed organic matter is mixed with the soil and gives this thin layer its dark color. Below this layer the surface soil is light brownish-yellow or yellowish-brown friable very fine sandy loam or loam to a depth of 6 or 7 inches. The subsoil is brownish-yellow or light-brown friable crumbly very fine sandy clay or heavy loam to a depth of 12 to 15 inches, where it gives way to decomposed sandstone. In some places, the subsoil is absent and the surface soil rests on sandstone. Many angular fragments of sandstone, 6 to 10 inches in diameter, are present on the surface. In some places large boulders lie on the surface, and small outcrops of bedrock appear here and there. This rough stony land includes the roughest and most broken areas of the Muskingsum soils. In most places the slopes range from about 30 to 80 percent, although about 7 percent of the land has slopes of 15 to 30 percent.

Because of the steep and broken relief and the presence of many small rock fragments and boulders, none of the land is used for crops. This rough stony land supports a second growth of trees, consisting of about the same species as those on Muskingsum stony very fine sandy loam.

The aggregate area of this rough stony land is about 12.6 square miles. Areas are in the eastern part of the county on Stone Mountain and on House and Barn Mountain; in the southeastern part on Beartown Mountain; along Clinch Mountain; in the northern part near Big A Mountain; in the northwestern part, especially on Buffalo Mountain; and in the western part on Pine Ridge.

Rock outcrop.—Rock outcrop includes bare exposures of bedrock on mountain slopes and stream bluffs. In the mountains the rock outcrops are mainly sandstone and in the valleys limestone. Bushes and stunted trees grow on ledges and in crevices in the outcrops, where sufficient soil material has accumulated to sustain them.

Large rock outcrops are shown on the soil map in outlined areas or are indicated by symbol as rock escarpments. Some outcrops of
rock are too small to show by outline or by escarpment symbol, and these are indicated on the map by rock-outcrop symbols.

About 256 acres of rock outcrop is included in outlined areas, mainly in the eastern part of the county on House and Barn Mountain.

Rock outcrops shown on the soil map by rock-outcrop symbols are in many parts of the county—on Stone Mountain in the southeastern part; near the crest of Clinch Mountain Spur, near the summit of Clinch Mountain, on Beartown Mountain, and on Clinch Mountain near Hayters Gap, in the northeastern part; in places near the Clinch and Little Rivers; in the northern part, northeast of Combs School, near Bradley Gap and Big A Mountain; and elsewhere.

Mine dumps.—This classification includes only 64 acres, mainly along Dumps Creek and its tributaries. It represents material taken from excavations for mines and has no agricultural value at present.

**PRODUCTIVITY RATINGS AND PHYSICAL LAND CLASSIFICATION**

In table 4 the soils of Russell County are rated according to their productivity of various crops under each of three levels of management and are grouped according to their physical suitability for agricultural use.\(^{11}\)

The rating compares the productivity of each soil for each crop to a standard of 100. This standard index represents the approximate average acre yield obtained without the use of fertilizers and other amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. An index of 50 indicates that the soil is about half as productive of the specified crop as is the soil with the standard index. Soils given amendments, such as lime or commercial fertilizers, or unusually productive soils of small extent may have productivity indexes of more than 100 for some crops.

The crop productivity indexes and the order of grouping the soils are based on observations in the field, interviews with local farmers, information furnished by the county agricultural agent, data given by agricultural specialists of the Virginia Agricultural Experiment Station and the Virginia Agricultural and Mechanical College and Polytechnic Institute, records of agencies of the Federal Government, and statements of fertilizer dealers and others experienced in the agriculture of the county. Because of a lack of adequate crop yield data by soil types, however; the indexes represent estimates of yields rather than yield records.

The soils of Russell County differ widely in productivity and in measures of management. For this reason they are rated according to three different levels of treatment.

The indexes in column A refer to the yields that may be expected if no special practices are used to restore, maintain, or increase productivity. These are the yields that are obtained without the use of manure, lime, commercial fertilizer, or soil-improving crop rotations.

The indexes in column B refer to the yields that are obtained under the most common practices of soil management. On the soils of the

\(^{11}\) For discussion of this grouping of soils see p. 92 of this section and p. 17 in the section on Soils and Crops. This grouping is also used on the soil map accompanying the report.
uplands and terraces, the crops are grown in 4- or 5-year rotations and moderate applications of commercial fertilizer and lime are made. Land used for corn is treated with 100 to 150 pounds an acre of 20 percent superphosphate, and land used for wheat and other small grains is treated with 200 pounds of 4-12-4 fertilizer. Some farmers treat land used for wheat and other small grains with lime. Tobacco land is given an application of about 400 pounds of 3-8-5 fertilizer to the acre. The common rotation is (1) corn, (2) wheat or other small grain, and (3) hay for 2 years. The less common 5-year rotation is the same except that the third year is used for the production of hay and the fourth and fifth years are used in the growing of grass for pasture. The management and use of the soils of the first bottoms are somewhat different from those of the soils of the uplands and terraces. In the first bottoms corn is grown year after year or is alternated with hay crops. Wheat and other small grains are not ordinarily grown. Pasture land is treated every 3 or 4 years with about 200 pounds an acre of 16 percent superphosphate or its equivalent, or is limed. The pasture is kept fairly free of weeds and bushes.

The indexes in column C refer to yields obtained under the best feasible soil-management practices. The best practices on soils of the uplands and terraces include the growing of crops in rotations, making heavy applications of complete fertilizers to land for corn, wheat, and the other small grains, turning under clover sod, liming, applying barnyard manure, top-dressing row crops and hay crops lightly with triple superphosphate, selecting the best seed and most suitable varieties of plants, and adopting the best tillage practices and measures of soil conservation. Tobacco land is given an application of about 800 pounds an acre of good tobacco fertilizer and is top-dressed with muriate of potash. On the soils of the first bottoms high yields of corn and hay are obtained by applications of fertilizer, by liming where needed, and by the proper sequence of crops.

Soil-management practices for pasture include making rather heavy applications of 16 percent superphosphate or triple superphosphate, liming, keeping the pastures free of weeds and brush, protecting the land from overgrazing, reseeding the worn-out areas, and feeding stover to cattle during the winter on thin or eroded areas in order to make available to those areas the manure left by the animals.

Ratings for the unprotected condition only have been given to soils of the first bottoms, since no areas are definitely protected by dikes or levees. Flooding occurs most often in the winter and early spring, and little damage results to crops other than the winter grains.

As it is difficult to appraise accurately or to measure mathematically either the exact significance of a crop in the local agriculture or the importance and suitability of certain soils for particular crops, no attempt has been made in Table 4 to compute mathematically a general productivity grade.

Factors influencing the productivity of the land are mainly climate, soil (including drainage and relief), and management. Yields of crops over a long period of years furnish the best available summation of those factors contributing to productivity, and they are used whenever available. Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their
distribution, play in the agriculture of the county. The tables give a characterization to the productivity of individual soil types. They cannot picture the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types used for each of the specified crops.

Economic considerations have played no part in determining the productivity indexes, so the indexes cannot be interpreted directly into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land.

In the column headed "Physical land classification," the soil types, phases, complexes, and miscellaneous land types have been grouped according to their relative physical suitability for use into First-class soils, Second-class soils, Third-class soils, Fourth-class soils, and Fifth-class soils. This grouping of the soils is not to be taken as a recommendation for use of specific tracts of land. Its purpose is to provide information as to the relative physical adaptation of the various soils in the present agriculture. Information on a number of additional factors is necessary in order to make even general recommendations for land use, and specific recommendations to apply on any one farm would require knowledge and consideration of a number of other factors applying to that particular farm.

It may be said that, in general, under present conditions, First-class soils constitute good to excellent cropland, Second-class soils fair to good cropland, and Third-class soils poor to fair cropland. Fourth-class soils in nearly all places are physically unsuited for crops but are suited to pasture, for which purpose they range from low to exceptionally high in productivity. Fifth-class soils include land best suited to forest, although some of it may be used for crops and pasture.

LAND USES AND SOIL MANAGEMENT

Russell County lies largely in the valley of the Clinch River. The soils of this county are many and varied. Although coal mining on a commercial scale has been important since about 1904, agriculture has been the chief pursuit in the county ever since the advent of the earliest settlers. Climate, soil, character of relief, and stoniness determined in a large measure the course agriculture should take, and from almost the beginning it has centered in the raising of livestock (pl. 10, A, B, and C). Bluegrass was one of the first pasture grasses. When the trees in the limestone country were removed or deadened, bluegrass came in naturally. The climate, as well as certain soils, seems to furnish an ideal environment for the growth of this valuable plant. Throughout many agricultural districts of the county, steep slopes and stoniness exclude much of the land from practicable use in the growing of cultivated crops, but a large proportion of such land is pastured. Hence, although these soils have some favorable qualities for growing crops, adverse external conditions limit their use to the production of pastureage, or, in many places, to forestry.

From the pioneering days to recent times, agriculture was so managed that it was practically self-sustaining in the production of food, feed, and, in the earlier days, clothing for the families. In 1939, in terms of total population, the production of beef, mutton and lamb, corn, and possibly eggs showed a surplus; whereas that of pork, lard,
wheat, potatoes, and dairy products fell short. On the basis of farm population alone, even these less plentiful farm products, with the possible exception of potatoes, are produced in surplus.

The various soils of Russell County have been placed in five groups, based on the internal and external characteristics of each soil and on their relative productivity and suitability for use under current farming practices. The soils in these groups are designated as First-class soils, Second-class soils, Third-class soils, Fourth-class soils, and Fifth-class soils. The First-class soils have a total area of 14.6 square miles, the Second-class soils 33.7 square miles, the Third-class soils 54 square miles, the Fourth-class soils 157.7 square miles, and the Fifth-class soils 212 square miles.

Although the first three classes represent approximately the soils suitable for cultivation and show in a general way their relative productivity, it is possible to improve all the soils, and some of the Second-class soils may be improved to a point where crop yields are practically as good as those obtained on some First-class soils. For example, by the use of soil-improvement methods on Frederick cherty silt loam on a farm near Old Rosedale, the soil was built up so that it produced 60 bushels of corn to the acre, high yields of wheat, and about 2 tons of hay from two cuttings. These yields compare well with those obtained on Hagerstown silt loam, a First-class soil. The method of improving this soil was the growing of corn, wheat, and hay in rotation and the application of lime and superphosphate to corn and wheatland. Crop rotation is practiced on many farms. On the uplands the main rotation includes corn or tobacco followed in the fall by wheat, although some farmers sow barley, rye, or oats instead of wheat. The small-grain crop is followed by clover and grass for hay 1 or 2 years, but on some farms the grass is used as pasturage the last year. Another rotation employed is the same as the foregoing except that after small grain the land is kept in grass 3 to 4 years for pasturage. On soils in the first bottoms and on terraces the cropping plan is mainly corn for 1 year followed by grass for hay for 2 years. On some farms corn is grown on soils in the first bottoms without being succeeded by grass or other crops.

Probably 90 percent of the agricultural soils need lime, which is especially beneficial to the cherty or gravelly soils, such as Frederick cherty silt loam and Elliber cherty silt loam, that occur on so many of the limestone ridges. A few lime kilns are in operation in the county, and approximately 400 farms are making use of burned or ground limestone as a soil improver.

The county is fortunate in having, in many of the agricultural districts, limestone suitable for burning or grinding into agricultural lime and in having coal within its bounds at a reasonable price for use in lime kilns. Further use of lime is considered essential for soil improvement and for increasing crop yields.

Many of the soils respond readily to treatment with superphosphate. Broomsedge can be eradicated from pastures by the proper use of superphosphate, and when this plant is eradicated the carrying capacity of the pasture increases.

Elimination of steep land from cultivation is considered advisable for the best interest of agriculture and for the preservation of such land. First-class soils ordinarily do not have slopes steeper than 18 percent, and few Second-class and Third-class soils have slopes of
more than 30 percent. In general, slopes of 30 percent or more should not be cultivated; but, where smoother land is not available, necessity forces the steeper slopes into cultivation. On all the steeper slopes now cultivated the crop rotation should be lengthened by keeping the land in grass for longer periods. Strip cropping could be used to advantage on many of the steeper slopes. Practically all of the forested land should remain in forest for the protection of the soil.

Erosion is active on some of the soils, but in most places it takes the form of moderate sheet erosion and gully erosion. The severest erosion occurs in places that are left bare of crops during the winter. The better methods for controlling erosion seem to be the growing of winter cover crops and grass crops so as to keep the land protected by cover throughout the year.

Slip erosion is the typical form of erosion on Westmoreland silty clay loam. Much of this soil has a gradient of 30 percent or more, and the land is used largely for pasture. Although most of the areas showing this form of erosion are very small, they are conspicuous on the grass-covered slopes.

Many areas now cropped should be pastured or forested, and some areas now pastured should be forested. Shade afforded by such trees as black locust and black walnut in the pastures is considered beneficial to the pastures and a protection to the soil, particularly on some stony areas and on steep areas that can be more economically used for pasture than for forestry.

Livestock raising is important in Russell County. For the most economical improvement of livestock, more cattle should be bred on the farms and fewer should be purchased outside the county. In soil use as it relates to livestock, it is considered good practice that more sheep and light-weight cattle be added to the herds that graze on the steep slopes.

In tables 5, 6, and 7 are given experimental data gathered by the Washington County Station of the Virginia Agricultural Experiment Station, on corn, wheat, and clover and timothy hay, grown in rotation.

**Table 5.—Results of fertilizer experiments with corn on rotation plots at the Washington County Station, Glade Spring, Va., 1930–40, inclusive**

<table>
<thead>
<tr>
<th>Fertilizer treatments (per acre)</th>
<th>Without lime</th>
<th>With lime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total yield</td>
<td>Marketable</td>
</tr>
<tr>
<td></td>
<td>per acre</td>
<td>corn per</td>
</tr>
<tr>
<td>Check—no fertilizer 1</td>
<td>Bushels</td>
<td>Percent</td>
</tr>
<tr>
<td>300 pounds 0–16–0 2, 3</td>
<td>26.54</td>
<td>81.3</td>
</tr>
<tr>
<td>300 pounds 4–16–0</td>
<td>53.04</td>
<td>92.1</td>
</tr>
<tr>
<td>300 pounds 0–16–4</td>
<td>59.57</td>
<td>93.0</td>
</tr>
<tr>
<td>300 pounds 4–16–4</td>
<td>47.74</td>
<td>91.8</td>
</tr>
<tr>
<td>300 pounds 4–16–4</td>
<td>60.57</td>
<td>92.9</td>
</tr>
<tr>
<td>300 pounds 4–16–2</td>
<td>52.82</td>
<td>92.5</td>
</tr>
<tr>
<td>300 pounds 4–2–12</td>
<td>52.58</td>
<td>93.0</td>
</tr>
<tr>
<td>300 pounds 3–2–12</td>
<td>51.56</td>
<td>91.4</td>
</tr>
<tr>
<td>300 pounds 2–3–12</td>
<td>53.49</td>
<td>92.8</td>
</tr>
<tr>
<td>300 pounds 4–16–0</td>
<td>53.14</td>
<td>91.5</td>
</tr>
<tr>
<td>300 pounds 0–16–0</td>
<td>45.51</td>
<td>91.2</td>
</tr>
<tr>
<td>300 pounds 4–16–0</td>
<td>48.19</td>
<td>91.1</td>
</tr>
<tr>
<td>300 pounds 0–16–0</td>
<td>49.72</td>
<td>92.5</td>
</tr>
</tbody>
</table>

1 Average of 3 check plots.  
2 Average of 2 treatments.  
3 Fertilizer was applied broadcast for corn.  
4 Corn was top-dressed when about knee high with 22 pounds of nitrogen per acre. Nitrogen was derived from nitrate of soda, ammonium sulfate, and cyanamide, respectively.
TABLE 6.—Results of fertilizer experiments with wheat on rotation plots at the Washington County Station, Glade Spring, Va., 1931-40, inclusive

<table>
<thead>
<tr>
<th>Fertilizer treatments (per acre)</th>
<th>Without lime</th>
<th>With lime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total yield per acre</td>
<td>Yield of straw per acre</td>
</tr>
<tr>
<td>Checks—no fertilizer 1</td>
<td>Busheis</td>
<td>Pounds</td>
</tr>
<tr>
<td>300 pounds 0-16-0 1</td>
<td>19.50</td>
<td>2,009</td>
</tr>
<tr>
<td>300 pounds 4-16-0</td>
<td>20.74</td>
<td>2,347</td>
</tr>
<tr>
<td>300 pounds 0-16-4</td>
<td>17.34</td>
<td>1,745</td>
</tr>
<tr>
<td>300 pounds 4-16-4</td>
<td>21.79</td>
<td>2,388</td>
</tr>
<tr>
<td>300 pounds 2-12-2</td>
<td>20.30</td>
<td>2,136</td>
</tr>
<tr>
<td>300 pounds 4-12-4</td>
<td>19.61</td>
<td>2,062</td>
</tr>
<tr>
<td>300 pounds 4-12-4</td>
<td>20.25</td>
<td>2,112</td>
</tr>
<tr>
<td>120 pounds 10-30-10</td>
<td>20.33</td>
<td>2,177</td>
</tr>
<tr>
<td>300 pounds 18-20-0</td>
<td>21.73</td>
<td>2,330</td>
</tr>
<tr>
<td>300 pounds 18-20-0</td>
<td>21.40</td>
<td>2,480</td>
</tr>
<tr>
<td>300 pounds 0-16-0</td>
<td>20.46</td>
<td>2,194</td>
</tr>
<tr>
<td>300 pounds 0-16-0</td>
<td>19.89</td>
<td>2,042</td>
</tr>
</tbody>
</table>

1 Averahe of 3 check plots
2 Average of 2 treatments.
3 Wheat was top-dressed with 22 pounds of nitrogen per acre in March. Nitrogen was derived from nitrate of soda, ammonium sulfate, and cyanamide, respectively.

TABLE 7.—Results of fertilizer experiments with clover and timothy hay on rotation plots at the Washington County Station, Glade Spring, Va., 1932-40, inclusive

<table>
<thead>
<tr>
<th>Fertilizer treatments for preceding corn and wheat crops (per acre)</th>
<th>Yield (per acre) of clover and timothy hay</th>
<th>Fertilizer treatments for preceding corn and wheat crops (per acre)</th>
<th>Yield (per acre) of clover and timothy hay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without lime</td>
<td>With lime</td>
<td>Without lime</td>
</tr>
<tr>
<td>Checks—no fertilizer 4</td>
<td>Pounds 1</td>
<td>Pounds 1</td>
<td>825</td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>2,578</td>
<td>3,351</td>
<td></td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>2,550</td>
<td>3,270</td>
<td></td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>1,884</td>
<td>2,637</td>
<td></td>
</tr>
<tr>
<td>300 pounds 4-16-4</td>
<td>2,645</td>
<td>3,974</td>
<td></td>
</tr>
<tr>
<td>300 pounds 4-12-2</td>
<td>2,648</td>
<td>3,298</td>
<td></td>
</tr>
<tr>
<td>300 pounds 4-12-4</td>
<td>1,784</td>
<td>3,106</td>
<td></td>
</tr>
<tr>
<td>300 pounds 4-12-4</td>
<td>1,897</td>
<td>2,740</td>
<td></td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>2,792</td>
<td>2,642</td>
<td></td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>2,755</td>
<td>2,779</td>
<td></td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>2,132</td>
<td>2,591</td>
<td></td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>1,963</td>
<td>2,604</td>
<td></td>
</tr>
<tr>
<td>300 pounds 0-16-0 4</td>
<td>2,159</td>
<td>2,918</td>
<td></td>
</tr>
</tbody>
</table>

1 Air-dry.
2 Average of 3 check plots.
3 Average of 2 treatments.

Practically all of the crops were grown on Dunmore silt loam, and, although this soil has a comparatively small total area in this county, the data given may be useful as a guide or may be actually applicable to many of the better soils of the uplands. The tables show the results of experiments conducted for the most part over a period of several years on the experiment farm near Glade Spring and at other places in Washington County near Glade Spring. The results represent possibly the nearest available data based on experiments in the general region of Russell County.

Experiments with corn, wheat, and clover and grass were conducted in a 3-year rotation of corn the first year, wheat the second year, and clover and grass the third year. Corn was planted in hills 60 inches apart, and two stalks of corn were left in each hill. Wheat was sown at the rate of 1 1/2 bushels an acre, and V. P. I. 131 was the variety grown. Clover and timothy were sown as near the first of April as
was practicable. The clover seed was sown at the rate of 15 pounds
an acre, and timothy seed at the rate of 3 pounds. Fertilizer was
applied in the row under corn, except as indicated in table 5. Fertil-
izer was drilled with the wheat in all places, and none was applied
to the land at the seeding of clover and grass. The usual application
of fertilizer was 300 pounds an acre under corn and the same quantity
under wheat.

The lower half of each plot was given an initial application of 3
tons of ground limestone an acre and an additional application of 1
ton an acre in each rotation, or every 3 years.

The land for corn was plowed as early during the preceding winter
as possible and was put in good condition before the seed was planted.
The corn was plowed and hoed as often as necessary to keep out grass
and weeds. For these experiments the plots in one rotation were one-
twentieth of an acre each and were not duplicated; in the other two
rotations the plots were one-fourtieth of an acre each and were
duplicated.

In the fertilizer mixture, such as the 4-8-4 grade, the first figure
indicates the percentage of actual nitrogen, the second figure the
percentage of phosphoric acid (P₂O₅), and the third figure the per-
centage of potash (K₂O). The nitrogen was derived as follows:
One-third from nitrate of soda, one-third from ammonium sulfate,
and one-third from cottonseed meal. The phosphorus was derived
from superphosphate, and the potash from muriate of potash.

The results of the experiments as shown in tables 5, 6, and 7 seem
to indicate that phosphorus is the most deficient plant nutrient in
the Dunmore soil. Superphosphate brought about practically all of
the increases in yields over those of the check plots. In places where
nitrogen and potash were added to superphosphate, slightly increased
crop yields nearly always resulted, provided the quality of super-
phosphate was not reduced. Potash on the plots fertilized with
0-16-4 fertilizer shows a depressive effect on the average yields.
During the 1937 season, however, corn on those plots that received
nitrogen and no potash gave indications of a deficiency of potash, but
thus far the deficiency has not affected yields to a great extent.
In the places where lime was used with the fertilizer in the rotation,
greatly increased yields of all crops resulted. The experiments show
that it is not expedient to broadcast fertilizer on cornland,
particularly in quantities as small as 300 pounds an acre.

In 1937 a few hybrid corn varieties were tried, and the yields of
these did not compare favorably with the old standard varieties,
because they had been developed for a shorter growing season and,
by maturing early, could not have the advantage of all the safe
growing season. This was true particularly of the yellow hybrid
varieties. Some new barleys that were tried gave promise of replac-
ing the old hooded and bearded varieties, but they need to be tested
further before their use can be recommended.

Table 8 gives 10 crop rotations conducted on Dunmore silt loam at
the Washington County Station farms at Glade Spring. Rotation
No. 6 resulted in serious washing of the land. In 1934 this rotation
was stopped and the land was seeded with alfalfa. Rotation No. 10
was discontinued after 1936.
### Table 8.—Average annual yield of different crops grown in different rotations at the Washington County Station, Glade Spring, Va., 1930-40, inclusive

<table>
<thead>
<tr>
<th>Rotation No.</th>
<th>Rotation</th>
<th>Corn</th>
<th>Stover</th>
<th>Wheat</th>
<th>Straw</th>
<th>Hay</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Corn 1 year, sweetclover 1 year</td>
<td>140 80 Bushels</td>
<td>12,243 Pounds</td>
<td>23.30</td>
<td>2,473</td>
<td>3,846 Pounds</td>
</tr>
<tr>
<td>2</td>
<td>Corn, wheat, red clover, each 1 year</td>
<td>60.28 Bushels</td>
<td>2,250 Pounds</td>
<td>25.37</td>
<td>3,088</td>
<td>3,288 Pounds</td>
</tr>
<tr>
<td>3</td>
<td>Corn, barley, red clover, each 1 year</td>
<td>48.22 Bushels</td>
<td>3,088 Pounds</td>
<td>25.37</td>
<td>3,412</td>
<td>3,928 Pounds</td>
</tr>
<tr>
<td>4</td>
<td>Corn 1 year, red clover and timothy 2 years</td>
<td>48.30 Bushels</td>
<td>2,010 Pounds</td>
<td>21.11</td>
<td>1,179</td>
<td>1,079 Pounds</td>
</tr>
<tr>
<td>5</td>
<td>Corn 1 year, wheat 1 year, red clover</td>
<td>54.61 Bushels</td>
<td>2,907 Pounds</td>
<td>21.11</td>
<td>2,150</td>
<td>3,053 Pounds</td>
</tr>
<tr>
<td>6</td>
<td>Corn, wheat, red clover, each 1 year,</td>
<td>53.11 Bushels</td>
<td>2,726 Pounds</td>
<td>19.85</td>
<td>2,020</td>
<td>2,582 Pounds</td>
</tr>
<tr>
<td>7</td>
<td>Corn, wheat, and red clover, 1 year,</td>
<td>50.20 Bushels</td>
<td>2,501 Pounds</td>
<td>19.85</td>
<td>2,141</td>
<td>3,149 Pounds</td>
</tr>
<tr>
<td>8</td>
<td>Corn 1 year, wheat 2 years, and red</td>
<td>55.85 Bushels</td>
<td>2,861 Pounds</td>
<td>19.85</td>
<td>2,141</td>
<td>3,149 Pounds</td>
</tr>
<tr>
<td>9</td>
<td>Corn 1 year, and alfalfa and timothy 4 years</td>
<td>57.40 Bushels</td>
<td>3,048 Pounds</td>
<td>19.85</td>
<td>2,141</td>
<td>3,149 Pounds</td>
</tr>
</tbody>
</table>

1 Average for 1933-36, inclusive.

The plots were one-twentieth of an acre each for all these rotation experiments, and each plot represented a field. In the corn and grain rotations, wheat followed corn. Timothy was seeded with wheat or barley in the fall, and clover was seeded in the wheat or barley in the spring. In the alfalfa plots, alfalfa was seeded in corn stubble land in the spring.

All the plots were limed at the beginning of the tests at the rate of 3 tons of ground limestone to the acre. Plots with grain and clover rotations were given additional lime the sixth year, at the rate of 2 tons of ground limestone to the acre. Plots with grain and clover rotations were treated with 300 pounds an acre of 4-12-4 fertilizer for both corn and wheat, making a total of 600 pounds of fertilizer during a rotation. These quantities of lime and fertilizer were not sufficient for successful yields of alfalfa, and in 1934 additional lime was applied to all alfalfa plots at the rate of 3 tons an acre. When corn was grown in the rotation with alfalfa the land was fertilized with 4-12-4 at the rate of 300 pounds an acre. The alfalfa plots were fertilized at each seeding of alfalfa at the rate of 400 pounds of 4-16-4 to the acre. Fairly successful results were obtained with these crop combinations, but there is still much need for improvement. In 1938, fertilizer and other changes were started so as to make the various tests more useful.

Experimental plots located on a farm near United States Highway No. 11, in the eastern part of Washington County, Va., predominantly on Dunmore soils, reveal that superphosphate on permanent pasture or meadow sod in most places requires about 2 years to bring about material results; that superphosphate is the only fertilizer that makes a fair profit on this good soil that overlies limestone; that lime applied to the land in addition to superphosphate reduces the profit on the soils having a pH value of about 6; and that the grazing capacity of fertilized land is so increased that the amount of land required to graze and to finish a steer properly is nearly everywhere considerably less than of unfertilized land.

Moreover, fertilization of the pasture land lengthens the grazing period by several weeks and thereby reduces the cost of wintering.
cattle. In addition, when cattle and lambs are grazed on fertilized pastures, their quality or grade generally is improved.

It seems that superphosphate as fertilizer for pastures is the solution to the economical management of pastures on the more fertile limestone soils. Furthermore, it seems that experiments will be necessary to determine the quantity of superphosphate to use and how often the superphosphate should be applied to the land. Further information can be obtained from Virginia Agricultural Experiment Station Bulletin 330.12

WATER CONTROL ON THE LAND

Water control on the land consists of practices having to do with the regulation of runoff and with the maintenance of favorable soil moisture conditions. These practices may be grouped as follows: (1) Control of runoff and erosion, (2) protection from floods, (3) drainage, and (4) irrigation. In Russell County the control of runoff and resulting erosion is the most important of these water-control measures, although artificial drainage and protection from overflow are important in some places. Irrigation is of little or no importance at present, although doubtless it would increase production of crops in dry seasons. Its use to supplement rainfall might prove to be economically feasible at times, especially on gardens and on small areas of high-priced crops, such as vegetables, fruits, and tobacco.

Water is the chief natural agent of soil erosion in Russell County. Soil erosion is of two kinds, normal and accelerated. Normal erosion is that "characteristic of the land surface in its natural environment, undisturbed by human activity, as under the protective cover of the native vegetation."13 Accelerated erosion refers to that "erosion of the soil or rock over and above normal erosion brought about by changes in the natural cover or ground conditions, including changes due to human activity and those caused by lightning and rodent invasion."13 As water is the principal active natural agent of soil erosion in Russell County, and as accelerated or man-induced erosion gives the greatest concern, the term "erosion" as used hereafter in this discussion means accelerated erosion by water (pl. 11, 4).

Because water is the chief agent of erosion in Russell County, the farmers' problem may be more correctly that of the proper use, conservation, and control of the water on the fields, pastures, and wood lots where it falls. The proper use and control of water where it falls is an effective measure for conserving the soil. Such control of the water brings about a number of desirable effects. One of these is the checking of erosion. Others include a more uniform and adequate supply of moisture for growing crops; improved tillage conditions, or working properties of the soils, particularly during periods of low rainfall; better conditions for biological activity; and improved conditions for the formation and conservation of humus. The desirable effects, in turn, facilitate further conservation and control of the water.

A. Accelerated erosion on Frederick cherty silt loam, steep phase—the result of a hard rain on the unprotected steep area.  
B. Slip erosion on Westmoreland silty clay loam.
Bluegrass has been an important plant since the beginning of agriculture in this county. It came in spontaneously as soon as the land was cleared, and covered much of the valleys, hills, and mountainsides. Consequently, erosion has not been so extensive or so destructive of soil as it has been in some sections of the country where slopes are gentler but are not protected by a cover of grass.

In the soil survey of Russell County no large areas of eroded soil are mapped, although many small areas are indicated on the soil map by symbols. These eroded areas range from mere spots to about 2½ acres. Some of the symbols indicate moderate sheet erosion, gully erosion, or both; and others indicate severe sheet or gully erosion. Slip erosion takes place on steep slopes of Westmoreland (pl. 11, B), Litz, and Upshur-Litz soils, overlying shale or interbedded shale and limestone even if they are well-sodded, as the entire soil mass down to bedrock slips down the slopes. Although these eroded areas are comparatively small, they are the warning signs of more severe and more extensive erosion to come, unless remedial measures are taken to stop erosion in its initial stages.

Soil erosion in Russell County, however, is not a problem in itself and cannot be treated or dealt with as such. It is a conspicuous symptom of more deeply seated disorders in land use and soil management.14

Failure to control water on the land and consequent soil erosion in Russell County have resulted from the failure to make needed adjustments of land use and soil management to the physical capabilities and character of the soils. Evidences of erosion indicate that such adjustments have not been made everywhere.

The land in Russell County is subdivided into comparatively small operating units, and each unit is controlled and operated by an individual farmer. Such readjustments must be effected, therefore, on these individual farms, and the approach is through each operator. It may be said, therefore, that in the last analysis the problem of water erosion control is one of farm management.

The farmer who attempts to readjust the use and management of his soils to effect control of water and erosion is confronted with a number of conditions, over some of which he as an individual has no control. Among such factors to be dealt with are (1) size and type of farm; (2) physical character of the land, including the pattern of the farm; (3) the surrounding social and economic conditions, such as transportation, market, church, and school facilities; (4) the immediate cash demand on the farm income for such items as taxes, indebtedness, and support of family; (5) the relation between prices of farm products and other commodities; (6) facilities and resources for operating the farm, including buildings, farm equipment, seed, kind and number of livestock, cash, and credit; (7) individual ability, aptitude, versatility, and preferences; (8) community cooperation, labor, farm machinery, drainage, water disposal, marketing, and buying; and (9) farm tenure and labor conditions.

14 The terms "land use" and "soil management" as used here mean the use and management of land or soil for the production of plants only. Land use refers to broad farm uses such as growing intertilled or clean-cultivated crops, close-growing crops (small grains, grasses, and legumes), permanent pasture, and forest. Soil management includes such practices as the choice and sequence of crops, tillage practices, green manuring, liming, fertilization, and mechanical measures for water control.
As important as it may be that land use and soil management be adjusted to the physical capabilities and character of the soil, it is apparent that such adjustments cannot be effected rapidly on all farms under present conditions. On some farms the physical use capabilities and management requirements of the soil conflict with immediate requirements of the farm, which are determined by other factors. Compromises are not only expedient but inevitable on many such farms. Realizations of land use and management to effect better control of water and thus check erosion are involved and complicated undertakings, and thorough familiarity with all factors is essential to any rational approach.

Since control of erosion is one result of proper water control on the land where it falls, and since such control of water is effected through the adjustment of land use and soil management to the physical capabilities and character of the soils, the problem is reduced to that of correcting land use and soil management. Certain mechanical means of controlling runoff and erosion, such as contour tillage, terracing, or strip cropping, should be resorted to if steep erodible land is to be cultivated; but wherever feasible such land should be used for close-growing crops or for pasture or trees.

**MORPHOLOGY AND GENESIS OF SOILS**

Soil is the product of forces of weathering and soil development acting on the parent soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and has existed since accumulation, (3) the plant and animal life in and on the soil, (4) the relief, or lay of the land, and (5) the length of time the forces of development have acted on the material. External climate, although important in its effects on soil development, is less so than internal soil climate, which depends not only on temperature, rainfall, and humidity, but on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Russell County is in the Gray-Brown Podzolic soil region of the United States, but is near the northern boundary of the region of Red and Yellow Podzolic soils, and some soils of the last two groups have developed in the county. The soils are generally light in color. They range from reddish brown to grayish yellow and light gray in the surface soil and from brownish red to light brown and yellow in the subsoil. The surface soil is prevailing fine textured, and much silt and clay and some fine sand are present in this layer. Angular sandstone fragments are strewn over the surface of a large part of the soil on mountains and on valley uplands near the base of mountains. Chert and, in some places, shale fragments are scattered over the surface of soils on ridges in the lowland belt, and many small outcrops of limestone bedrock appear in the limestone areas. The surface soil is friable in most places and rather heavy and somewhat plastic in some places. The subsoils generally are friable, and none of them is so heavy and plastic as the subsoil of soils of the Fredell series in the Piedmont Plateau or the subsoil of soils of the Susquehanna series in the Gulf Coastal Plain.
In the winter the ground is frozen to only slight depths and for only short periods; hence, soil leaching is interrupted very little by freezing. The average annual rainfall of 51 inches is well distributed through the year, although it is somewhat heavier in the spring and summer than in the fall and winter. Because of active leaching, promoted by the warm temperature and by the rather heavy and well-distributed rainfall, the surface soils are comparatively low in available mineral plant nutrients. Even though calcium carbonate is a mineral component of many of the rocks from which the soils are formed, most of the soils are naturally acid, although in a few places on the uplands and in some places in first bottoms, sufficient calcium carbonate is present in the soil to give an alkaline reaction. The soils commonly range from slightly acid to strongly acid.

Forest doubtless originally covered the territory in which Russell County is located, and the soils were formed under forest consisting of oak, hickory, chestnut, tuliptree, and other deciduous trees. During the course of soil formation very little of the organic matter shed by the forests accumulated in the soils. In the present forested areas, which occur mainly in the mountains and in the rough country in the lowland belt, a thin layer of leafmold and forest litter rests on the soil, and a small quantity of organic matter derived from decayed leaves and twigs is mixed with the first inch or so of the surface layer. In some favorably located places, such as the heads of coves, slightly more organic material has collected on the surface and in the first few inches of the surface layer than on ridges. In some soils in the limestone areas in the lowland belt and in the soils in first bottoms a fairly large quantity of organic residue appears to be thoroughly incorporated with the mineral material of the surface soil. This condition may be the result of a different, probably more luxuriant, native vegetation on these soils, and possibly of the formation of a different, more stable, kind of organic matter than on the thinner, less fertile, and less moist soils on mountains and ridges underlain by sandstone and shale, or than on the cherty soils. Some of these darker soils may be Brown Forest soils, and some may be Rendzinas.

ORIGIN OF PARENT MATERIALS

Sedimentary rocks, consisting of limestone, shale, and sandstone, underlie all the soils of Russell County. Conglomerate is present in comparatively thin beds in some places. Coal is interbedded with sandstone and shale in places in the northern part.

The limestone, shale, and sandstone present considerable variation. In large areas some of the calcium in limestone has been replaced by magnesium, giving rise to magnesium limestone, or dolomite. In other large areas the limestone contains clayey material, which is the most common impurity in limestone; and when the limestone is broken down through solution, a soft shaley material is left in many places. In some formations the limestone is interbedded with shale in about equal proportions; in some other places it is in a greater proportion than the shale; and elsewhere it is in a smaller proportion than the shale. Limestone in some large areas contains chert, a hard flintlike mineral composed of silica. Another condition of limestone covering large areas is the presence of comparatively thin beds of quartz sandstone.
The shale in this county is black and hard and breaks up into thin fissile plates. It is rather resistant to the agencies of weathering. Some of the shale, however, is softer and weathers to greater depths than the hard black shale. Mica is present in the shale in some areas and sericite in other areas. The sandstone is siliceous, although in the northern part the sandstone in some formations apparently contains feldspar or mica.

During the process of their formation, the sedimentary rocks doubtless occupied a horizontal position; but since their formation great earth movements folded, faulted, and broke the rock beds to such an extent that the rocks retain their former flat position only in comparatively small areas.

The different rocks offer unequal resistance to weathering. Sandstone is the hardest rock and withstands weathering the longest time. Some of the mountaintops are capped by a layer of sandstone that has withstood weathering for long ages. Shale is less resistant to weathering than sandstone and breaks down to soft friable rock material. Limestone seems to be the least resistant to weathering agencies and disappears through dissolution rather than through disintegration as do sandstone and shale.

When the rock strata were finally upturned by folding and breaking, alternating beds of hard and soft rocks appeared at the surface of the earth, and the agencies of weathering carved from the different rock formations a series of valleys and ridges characterized by rolling, hilly, and steep relief in the areas of softer rock and by steep-sided and narrow-crested ridges and mountains in the areas of harder rock. The more nearly pure limestone, being soft, disappeared through solution, and some of the lowest uplands in the county are underlain by the softest limestone. Throughout the limestone belt, however, resistant material, such as shale, sandstone, and chert, present in the limestone formation, have given rise to ridges, hills, and knobs.

It was through the breaking down of the rocks that mineral material became available for soil formation, and it was through the varying resistance of different rocks to weathering that great inequality in land surface was brought about. The character of the parent material derived through the decay of the various rocks and the many land forms are perhaps the greatest factors in the formation of the soils of Russell County. The influence of the rock on soil formation is evident in many places. Sandstone is interbedded in some places with limestone, and the soil developed over the sandstone has a thicker and more leached surface soil and a more friable subsoil than the associated soils developed over limestone alone. In the places where chert is an abundant constituent of limestone, the chert, being very resistant to weathering processes, is left as a component of the soil when the limestone bedrock is dissolved. Soil developed from the residue of such limestone contains an abundance of small angular chert particles, and the surface soil in most places is comparatively thick and well leached. Another condition of soil brought about by the character of the parent rock is present in a soil complex developed over closely bedded purplish-red and yellow-brown shale. The color of the rocks has been transmitted to the overlying soil, and small areas of purplish-red soil and light-brown
soil have developed side by side. In these areas neither time nor any soil-forming process has effaced the color that these rocks imparted to the soil.

In many places weathering has not completely broken the rocks down, and fragments of sandstone, shale, and chert remain on and in the soil. These fragments are still in the process of disintegration, and new material is added to the soil as they break down.

Normal erosion on steep slopes in the sandstone and shale areas carries away the soil almost as fast as it forms from the thin layer of decomposed rock material that underlies the soil. Hence, in these sandstone and shale areas the solum is thinner in most places than the solum developed in gently sloping areas in the limestone belt.

Although the rocks vary considerably in structure and composition, they may be classed, so far as their relation to soil formation is concerned, into a few groups as follows: Limestone, cherty limestone, argillaceous limestone, interbedded limestone and shale, noncalcareous shale, and noncalcareous sandstone.

The parent material for the soils consists of two classes, namely, (1) residual material derived from the decomposition of rocks in place and (2) secondary material, or material removed from its original position and deposited on valley uplands or along streams. The first class of soil material includes the residue of dissolved limestone and the soft material of weathered sandstone and shale. The second class includes rock fragments and other rock waste that were moved mainly by gravity and local wash from mountain slopes and deposited on valley uplands; rainwash and creep material deposited at the base of slopes mainly in the valley uplands; and alluvial material derived from upland slopes and deposited near streams by running water. The alluvial material occupies terrace positions and first bottoms near streams.

Rocks of the Paleozoic era underlie Russell County, and, with the possible exception of the Permian rock system, all the rock systems of that era are in the county. These rock systems, in the order from the oldest to the youngest, are as follows: Cambrian, Ozarkian,\(^5\) Canadian,\(^6\) Ordovician, Silurian, Devonian, Mississippian, and Pennsylvanian.

In this county the Cambrian system is represented by the Rome formation; by Rutledge limestone, Rogersville shale, and Maryville limestone in a group; by Honaker dolomite; and by Nolichucky shale. The Ozarkian system is represented by the Copper Ridge dolomite, and the Canadian system by the Beekmantown dolomite, and possibly areas of Bellefonte dolomite. The Ordovician system is represented by Mosheim limestone and Lenoir limestone, which appear mostly together; by the Holston limestone and Ottossee limestone, which are present in the same belt; by Moccasin limestone; and by Martinsburg shale. The Silurian system is represented by the Juniata formation and Clinch sandstone. The Devonian system is represented by the Onondaga limestone; by the formation commonly referred to as "black shale;" and by Brallier (Upper Portage) shale. The Mississippian system is represented by Price sandstone; by St.

\(^5\) The uppermost part of the Upper Cambrian of the United States Geological Survey.

\(^6\) The lowermost part of the Lower Ordovician (or Beekmantown part) of the United States Geological Survey.
Louis limestone, Ste. Genevieve limestone, the Gasper formation, and Glen Dean limestone, as a group; by Big Stone Gap shale, in part Mississippian; and by the Pennington formation. The Pennsylvanian system is represented by the Lee formation, by the Norton formation and Gladeville sandstone in the same formation, and by the Wise formation.

Soils developed from rock material weathered in place include members of the Hagerstown, Pisgah, Decatur, Dunmore, Frederick, Elliber, Clarksville, Lodi, Bolton, Carbo, Bland, Tumbez, Westmoreland, Upshur, Litz, Wellston, Muskingum, Lehew, and Montevallo series.

Soils of the Hagerstown series are underlain by Rutledge limestone, Maryville limestone, or Holston limestone. Rutledge limestone, Rogersville shale, and Maryville limestone appear together in a rather large formation in the northwestern part of the county near and southwest of Castlewod. Rutledge limestone consists of fine-banded limestone, and Maryville limestone is comparatively thick-beded blue partly banded limestone. Rogersville shale is yellow or gray-green shale containing thin layers of sandstone. Rogersville shale disappears near St. Paul, and Rutledge limestone and Maryville limestone give way to Honaker dolomite.

Members of the Pisgah series are underlain by Holston limestone, Lenoir limestone, and Mosheim limestone. Holston limestone and Ottossee limestone appear together in two rather wide northeast-southwest belts that cross the county. One of these belts is near Dickensonville, Lebanon, and Blackford and the other is near Belfast Mills, Elk Garden, and Hansonville. A small area of the rocks is near Rockdell. Holston limestone is thick-beded, coarsely crystalline, and light gray to dark gray. This rock is well exposed in fields near Hansonville and near Lebanon. Lenoir limestone and Mosheim limestone appear together in most places in the county. Two narrow belts containing these two limestones extend in a northeast-southwest direction across the county. One of the belts lies near Belfast Mills, Elk Garden, and Hansonville and the other near Blackford, Lebanon, and Dickensonville. Several areas of these rocks are in the northern part of the county north and east of Honaker. Lenoir limestone is dark or black, medium coarse grained, and generally full of nodules of black chert. Beds of nodular gray argillaceous rock generally appear in this rock. Mosheim limestone is a pure limestone, compact or glassy textured, rather thick-beded, in most places light gray but in some places dark gray.

Soils of the Decatur series are developed from the weathered material of Maryville limestone. The soils of the Dunmore series have developed from the residuum of Beekmantown dolomite. The Beekmantown group in this county includes Nittany dolomite and probably areas of Bellefonte dolomite. Most of the Beekmantown formation is contained in two wide belts that cross the northern half of the county in a northeast-southwest direction. A narrow belt of the rock is in the northern part east of Honaker. The Beekmantown formation consists of gray thick-beded medium coarse grained dolomite that yields a large quantity of chert.

Soils of the Elliber series have formed from the residual products of Nittany dolomite, Honaker dolomite, St. Louis limestone, and Copper Ridge dolomite. Copper Ridge dolomite appears mainly in
two wide belts in the northern and western parts of the county. One of these belts crosses in a northeast-southwest direction south of Castlewood, Cleveland, and Honaker, and the other belt enters from Scott County and extends northeastward by Lebanon almost to Belfast Mills. Copper Ridge dolomite is gray thick-bedded cherty dolomite which is rather uniform in character. Beds of quartz sandstone are distributed throughout this dolomite.

Soils of the Clarksville series are derived from the residuum of weathered Beekmantown formation, Honaker dolomite, Copper Ridge dolomite, and Onondaga limestone. Small areas of the Onondaga limestone occur in the eastern part of the county. In the southwestern part of Virginia the Onondaga limestone is mainly dense, thick-bedded rugged chert on weathered outcrops. A few fresh exposures indicate that the unweathered limestone is medium thick-bedded, blue gray, and cherty.

Soils of the Lodi series have formed from the weathered products of Copper Ridge dolomite and Honaker dolomite. Those of the Bolton series are derived from the residue of weathered Nittany dolomite, Copper Ridge dolomite, and Honaker dolomite. Soils of the Carbo series have formed from the weathered products of Ottoease limestone, which appears in the same belts as Holston limestone. Ottoease limestone ranges from thin-bedded to nodular very fossiliferous limestone.

Members of the Bland series are derived from the residual products of Moccasin limestone, which appears in a narrow belt in the western and northeastern parts of the county. This belt extends almost across the county and is near Blackford, Lebanon, and Dickensonville. Another narrow belt of the rock is in the eastern part near Old Rosedale and north of Belfast Mills. Another narrow belt of the rock crosses through the southern and eastern parts at points near Belfast Mills, Elk Garden, and Hansonville. Moccasin limestone is characteristically red argillaceous limestone or mudstone, but the lower part consists of persistently blue limestone and layers of red rock here and there. Within the main mass of red rock are also a few layers of pure blue limestone. Two or three beds of sandstone and fine conglomerate are present in the upper part of the Moccasin limestone.

Soils of the Tumbez series have probably formed from the weathered material of Bellefonte dolomite, which is associated in development with the Nittany dolomite that appears in two broad belts in the northern half of the county. Bellefonte dolomite is the post-Nittany part of the Beekmantown group, and in the southwest part of the valley northwest of Bristol it is a cherty dolomite much like Nittany dolomite. In Lee, Scott, and Russell Counties a bed of gray and red shale containing layers of somewhat pink dolomite in and just above the dolomite possibly belongs in the Bellefonte division. It is from the weathered material of this included rock that soils of the Tumbez series have probably formed.

Members of the Westmoreland series are derived from weathered material of Martinsburg shale and Nolichucky shale. Martinsburg shale occupies the rather wide belt that crosses the southern part of the county along the north slope of Clinch Mountain. Another rather wide belt of the rock begins a few miles east of Lebanon and extends northeastward into Tazewell County. Comparatively small areas of the shale are in the northern part northwest of Hon-
aker and east of Swords Creek. Martinsburg shale is predominantly shale containing thin layers of impure fossiliferous limestone and sandstone. In the median belts of the valley, limestone in thin beds appears in increased amount in the lower part of this shale and the limestone increases in proportion northwestward to the belts in which it becomes separable as Trenton limestone. Nolichucky shale is confined to the northern and western parts, mainly in two narrow belts. One of these extends in a northeast-southwest direction across the county; the other extends in the same direction almost across the county. Several areas of this shale are in the northwestern part, northeast and west of Castlewood and in the northern part, west of Honaker. Nolichucky shale is predominantly a soft somewhat green shale, which weathers to yellow material. The shale generally gives way to a blue-banded fossiliferous limestone, which is as much as 100 feet thick.

Soils of the Upshur series and the Litz series are developed in a complex. These soils are derived from the residuum of weathered rocks of the Rome formation. This formation is contained mainly in two belts in the northwestern part of the county. These belts extend from points near Castlewood northeastward by Cleveland to a point near Honaker, where they merge and extend into Tazewell County. Another fairly wide belt begins at a point southwest of Castlewood and extends into Scott County. Still another fairly wide belt of the formation extends from a point near Dickensonville southwestward into Scott County. The Rome formation is decidedly mixed. Its distinctive feature is its red color, due mainly to the red mudstone or shale present. It is composed principally of shale, sandstone, limy clayey beds, dolomite, and pure blue limestone. These rocks are present in comparatively thin beds that are distributed without regular order through the full thickness of the formation. About 75 percent of the formation is either red mudstone or green sericite shale in definite layers ranging from 1 foot to 50 feet in thickness. The sandstone present is commonly in thin beds, is generally fine-grained, and is red, brown, or green. The calcareous argillaceous beds in the formation weather to yellowish ocher, or less commonly, reddish ocher, through the leaching of the lime. The beds of dolomite and the rare beds of limestone present are as much as 50 feet thick, and together they compose probably not more than 10 percent of the formation. Soils of the Litz series also have formed from the residual products of weathered Nolichucky shale and Rogersville shale.

Members of the Wellston series have developed mainly from the weathered products of the Norton formation and Gladeville sandstone. This formation and the Gladeville sandstone appear together in two large areas, which cover most of the coal-field section in the northwestern and northern parts of the county. These two areas are separated by Big A Mountain, although both are part of a vast area of the Cumberland Plateau in the State. The Norton formation is composed of shale and a smaller proportion of sandstone. Some beds of the sandstone are conglomeratic. Eight to ten minable coal beds are in the formation. Gladeville sandstone is generally medium coarse grained, gray, thick- or thin-bedded, and arkosic.
Soils of the Muskingum series have formed from weathered material of Clinch sandstone, the Price formation, the Lee formation, the Wise formation, the Norton formation, and Gladeville sandstone. Clinch sandstone is confined almost entirely to the southeastern part of the county south of Belfast Mills. Small areas of the rock are in the northeastern part west of Old Rosedale, and southeast of Blackford. The rock forms the crest of Clinch mountain, but here only small areas of it are in Russell County. A narrow area of the rock is in the northern part of the county near Big A Mountain. Clinch sandstone is entirely sandstone and is white or gray, hard, and persistent. As this sandstone generally is steeply inclined, it nearly everywhere forms a high ridge along its outcrop. Clinch Mountain is an example of a ridge made by this hard sandstone, which is entirely nonmarine in origin. The Price formation appears in two narrow belts in the northern part of the county north of Cleveland and Artrip. This formation consists of a mixture of gray or greenish-gray sandstone and shale. The Lee formation also is in the northern part of the county, and it appears in comparatively narrow belts that adjoin the Gladeville sandstone belt. One belt of the Lee formation lies north of Carterton and Cleveland, and the other is north of Swords Creek. The Lee formation consists of conglomerate, sandstone, and shale. Several beds of workable coal are distributed through the formation, and in the eastern part of Tazewell County the well-known Pocahontas coals are in this formation. The Wise formation is confined to a few small areas in the extreme northwestern part of the county along and near the Russell-Dickenson County line. This formation is composed of shale and sandstone, but the proportion of shale is greater in this formation than in the Norton formation. Some of the higher sandstone beds in the Wise formation carry much arkosic material. The formation contains coal beds.

Soils of the Lebew series have formed from weathered material of the Juniata formation. The Juniata formation is distributed in the eastern, northeastern, and northern parts of the county near the Clinch sandstone areas, and in the southern part of the county near the top of Clinch Mountain. It is composed of red shale or mudstone and a smaller proportion of red sandstone. Some gray sandstone occurs near the top of the formation. For the most part, the formation is nonmarine. In the southwestern part of Virginia the marine Sequatchie facies of the formation, which contains a few layers of argillaceous limestone, gradually makes its appearance.

Soils of the Montevallo series are derived from the residual products of weathered Brailer shale, black shale of the Devonian age, and Big Stone Gap shale. Brailer shale comprises a comparatively small area in the northern part of the county several miles east of Swords Creek. Brailer shale includes both shale and sandstone, although the shale predominates. The shale consists of a mixture of siliceous, micaceous, stiff, thinly laminated slaty rock and of argillaceous laminated rather soft rock. The laminae of the siliceous shale are generally crinkled or wavy on the surface. The clay shale weathers to a yellow tint, and the siliceous shale is generally stained manganese black on weathered surfaces. The sandstone present is fine-grained and somewhat green and is in very even surfaced layers.
that are everywhere uniform in thickness. The layers are generally 1 to 12 inches thick, are separated by shale, and the entire mass is distributed in groups roughly estimated to be from 50 to 100 feet thick. A few beds of the sandstone are 20 feet or somewhat more in thickness, the fresh rock is somewhat green, and the weathered surface of the rock is greenish-yellow, greenish-brown, or rust-colored.

The black shale of the Devonian age appears in comparatively small areas in the eastern part of the county in association with Onondaga limestone. The shale is continuous with a part of the Romney shale, and it is predominantly a black fissile shale. Some beds of green shale and of gray shale are present in the black shale. Big Stone Gap shale is confined to comparatively small areas in the northwestern part of the county north of Cleveland. It consists mostly of black fissile shale, although in some areas it includes greenish-gray shale similar to Braillet shale. Thin layers of sandstone are present with black and dark-colored shale at the top of the Big Stone Gap shale.

Soils derived from material brought down from mountain slopes and deposited on valley floors mainly by the action of gravity are members of the Hayter series and the Jefferson series. This material occurs in several parts of the county at the base of mountain slopes or spread on valley uplands some distance from the mountains. The material consists of angular and subangular sandstone fragments, shale fragments, and possibly other rock waste, which are in beds ranging from a few to several feet in thickness. Much of this rock waste accumulated on or near uplands underlain by limestone and doubtless received calcareous material from the limestones. The material that gives rise to the soils of Hayter series perhaps has been derived in part from calcareous sources nearby.

Soils formed from rainwash and creep material that accumulated at the base of slopes include members of the Emory, Burgin, and Greendale series. These soils have formed in the limestone areas, and the material from which they have formed was derived from slopes underlain by limestone.

Soils derived from alluvial material are members of the Sequatchie, Holston, Huntington, Lindside, Melvin, Pope, Philo, and Atkins series, and alluvial soils, undifferentiated. The soils of the Sequatchie series and Holston series have formed on terraces near streams. The material for the soils of the Sequatchie series originally came from uplands underlain in places by calcareous rocks and in other places by noncalcareous rocks, and the material for the soils of the Holston series originally came from slopes of the uplands underlain by noncalcareous sandstone and shale. The soils of the Huntington, Lindside, and Melvin series have formed in first bottoms near streams from alluvial materials derived from uplands underlain by limestone. The soils of the Pope, Philo, and Atkins series have formed in first bottoms near streams from alluvium consisting of material derived from slopes of the uplands underlain by noncalcareous sandstone and shale. Alluvial soils, undifferentiated, occur in first bottoms near streams, and the materials were derived from uplands underlain by calcareous rocks and noncalcareous rocks.
GENETIC SOIL GROUPS

The soils of Russell County may be considered as belonging to three broad groups—zonal, intrazonal, and azonal soils. The profile of the zonal soil, or normal soil, presents a comparatively light textured and light colored surface layer, or A horizon, which overlies a thicker and heavier textured layer, the B horizon. The B horizon, in turn, overlies the parent material layer, or C horizon, which varies considerably in texture but in many places is lighter than the B horizon and heavier than the A horizon. The textures in these layers differ somewhat in the soils of the county. In the A horizon the texture is mainly silty clay loam, silt loam, and loam, and in the B horizon it is mainly silty clay, silty clay loam, loam, and fine sandy clay. The material of the C horizon is variable, depending on the composition and character of the material from which it is derived, and it consists of silty clay, silty clay loam, or fine sandy clay, which in some places is mixed with decomposed rock material or small angular chert fragments. The thickness of the horizons varies somewhat. That of the A horizon ranges from 5 to 6 inches in the silty clay loams and from about 8 to 12 inches in the silt loams and loams, whereas that of the B horizon ranges from about 15 to 20 inches in the silty clay loams and from about 15 to 38 inches in the silt loams and loams. The thickness of the C horizon, which is composed mainly of decayed rock, ranges from about 1 to 8 feet, or, in some places, considerably more.

Included with the zonal soils are Hagerstown silt loam, Pisgah silt loam, Dunmore silt loam, Frederick silt loam, Elliber cherty silt loam, Clarksville cherty silt loam, Lodi loam, Bolton loam, Carbo silty clay loam, Bland silty clay loam, Holston loam, and Wellston loam. Detailed descriptions of the profiles of these soils are given in the following pages. In addition to these zonal soils, other zonal soils are Hagerstown stony silty clay loam, Decatur silty clay loam, Frederick cherty silt loam, Elliber silt loam, Clarksville cherty fine sandy loam, and Bland stony silty clay loam.

All these zonal soils have well-developed characteristics that are the result of the climatic and vegetational forces that have acted on parent material occupying gently or moderately sloping areas. Although some of these soils contain a fairly large quantity of small angular chert fragments, they have well developed structural and textural profiles that conform favorably to what the climate and vegetation may be expected to produce.

The relief of the county varies so much that it was necessary to recognize phases of the zonal soil types based on the character of the relief, such as rolling, hilly, and steep. As these soil phases occupy slopes much different from those occupied by the soil types, some differences exist in the thickness of the soil layers and possibly in some places in the development of the soil in the layers. These differences, however, are what the various degrees of slope may be expected to cause, but they are not so great as to produce manifestly different soil profiles.

A description of a profile of Hagerstown silt loam, observed about 1 mile east of Lebanon in a cultivated field, is as follows:

A. 0 to 6 inches, brown mellow rather heavy silt loam. The soil apparently contains a fair amount of organic residue, which is incorporated with the mineral soil. When wet, the soil is dark brown.

A. 6 to 10 inches, light-brown friable silty clay loam of fine granular structure.
B. 10 to 34 inches, faintly reddish brown friable firm silty clay, which breaks into small angular soil aggregates. These aggregates are mingled brown and ocherous yellow on the inside and have a coating of dark reddish brown on the outside. A few small black mineral concretions are present in the clay.

B. 34 to 42 inches, slightly reddish-brown firm friable silty clay, somewhat heavier in texture than the clay in the overlying layer. Small black mineral particles are present in this horizon, and they are more numerous and slightly larger than those in the Bc horizon.

C. 42 to 48 inches, reddish-brown friable silty clay material containing small spots of faint ocherous yellow. A great many small black mineral concretions are in this layer. The clay of this horizon is more friable than that in the Bc and Bb horizons. This horizon is underlain by gray limestone bedrock at a depth ranging from about 48 to 80 inches, or somewhat more, below the surface.

In addition to the typical Hagerstown silt loam, the rolling, hilly, and steep phases of that type, and Hagerstown stony silty clay loam and its steep phase are mapped in the county. Hagerstown stony silty clay loam has an A horizon of brown or reddish-brown silty clay loam and a B horizon of brownish-red or reddish-brown firm but friable slightly plastic silty clay. Small outcrops of gray limestone bedrock occupy about 15 to 35 percent of the surface.

Pisgah silt loam in an area of grassland has the following profile:

A. 0 to 8 inches, brown mellow silt loam or heavy silt loam. A comparatively large quantity of organic residue appears to be incorporated with the mineral soil.

B. 8 to 38 inches, yellowish-brown friable crumbly silty clay loam, easily crushed to a fine-granular mass having no definite structure. Many small black mineral concretions are in the soil. A few light-gray angular chert fragments, ranging from about 1/2 to 1 inch in diameter are present. A cut surface of the horizon is lighter in color than a broken surface and is slightly brownish yellow. The soil of this layer has a slightly red cast when seen at certain angles, because of a dark-red coating on the breakage planes of the soil particles.

C. 38 to 45 inches, light yellowish-brown friable crumbly silty clay loam material containing a great many small black mineral particles and much black mineral film on breakage planes. A dark reddish-brown coating is on some of the cleavage planes. Small pieces of light brownish-yellow and almost white chert are in the material. Some of these chert particles are partly weathered and crush into a white chalky substance. The material in this layer is slightly lighter in color and slightly more friable than material in the B horizon.

This soil has developed from the residual product of gray limestone, which is probably high in calcium carbonate. Nodular and angular black and gray chert are embedded in the limestone. Besides Pisgah silt loam, two phases are mapped—Pisgah silt loam, rolling phase, and Pisgah silt loam, hilly phase.

Decatur silt clay loam has an A horizon of brown or reddish-brown silty clay loam ranging from about 8 to 12 inches in thickness, a B horizon of dark-brown, dark brownish-red, or maroon firm silty clay about 35 inches thick, and a C horizon of silty clay that is brownish red mottled or streaked with ocherous yellow, is fairly friable, and ranges from a few feet to many feet in thickness. Small black mineral concretions are numerous in the B and C horizons.

An area of Dunmore silt loam, about 3 1/2 miles northeast of Hansonville in a cultivated field, shows the following profile:

A. 0 to 6 inches, brown heavy smooth silt loam, which, when dry, is light grayish brown or very light brown.

A. 6 to 8 inches, yellowish-brown friable silty clay loam having a dark reddish-brown coating on the breakage planes.
B. 3 to 32 inches, slightly reddish brown tough somewhat plastic smooth silty clay that breaks into soil particles about 3/4 to 1/2 of an inch in diameter. With further pressure these particles break into still smaller particles. The clay in this layer takes a high polish on the cut surface. A few small spots of ocherus-yellow appear in the soil mass.

C. 32 to 45 inches, dark reddish-brown friable slightly plastic smooth silty clay loam containing small spots or streaks of ocherus yellow and very light gray. A few light-gray chert particles are on the surface and in the soil layers.

In addition to Dunmore silt loam, Dunmore silt loam, hilly phase, is recognized in this county.

In a pasture Frederick silt loam shows a profile as follows:

A. 0 to 7 inches, light grayish-brown friable silt loam, which is brown when wet.

A. 7 to 11 inches, mingled dark reddish-brown, light yellowish-brown, and ocherus-yellow friable silty clay loam.

B. 11 to 38 inches, brownish-red firm friable silty clay breaking into angular fragments 1 to 2 inches in diameter. These fragments break down to fine angular particles with slight pressure. A cut surface of the horizon is somewhat lighter in color than a broken surface.

C. 38 to 45 inches, slightly reddish brown friable silty clay loam, in which are small spots of dark reddish brown and ocherus yellow. A few almost white soft decomposed chert particles are in this layer.

On the surface of this soil and in the soil mass are a few gray and light-yellow chert fragments ranging from about 1 to 3 inches in diameter.

In addition to Frederick silt loam, the following soils of the Frederick series are mapped: Frederick silt loam, hilly phase; Frederick cherty silt loam; Frederick cherty silt loam, hilly phase; and Frederick cherty silt loam, steep phase. Frederick cherty silt loam and its phases are characterized by many light-gray angular chert fragments ranging in diameter from about 1/4 to 3 inches and in some places considerably more. These fragments are strewn over the surface, are in the A horizon, and appear in smaller quantities in the B and C horizons.

Elliber cherty silt loam in a cultivated field presents the following profile:

A. 0 to 7 inches, brown or grayish-brown friable silt loam containing from 15 to 35 percent of small light-gray and brownish-yellow chert particles ranging from about 1/4 to 1 inch in diameter. When the soil is dry the color is light grayish brown.

A. 7 to 18 inches, finely mingled brown and yellow friable silty clay loam containing many light-yellow partly decomposed chert particles.

B. 18 to 32 inches, light-brown friable silty clay containing very light-gray and ocherus-yellow fine motlings. Light-yellow and almost white decomposing chert fragments, about 1/4 to 1 inch in diameter, are mixed with the clay of this horizon. Some of the chert fragments when broken show a black coating on the fracture planes.

C. 32 to 42 inches, light-brown, mottled or mingled with rust-brown, very light-gray, and ocherus-yellow, friable silty clay loam, containing many fragments of almost white partly decayed chert ranging from about 1 to 2 inches in diameter. Some black mineral specks are present in this material.

Other Elliber soils mapped are the hilly and steep phases of Elliber cherty silt loam, Elliber silt loam, and Elliber silt loam, hilly phase. Elliber silt loam is similar to Elliber cherty silt loam in profile development, except that it contains no chert or only a small quantity.

In the Frederick and Elliber soil areas complexes of stony soils—Frederick-Elliber stony silt loams and Frederick-Elliber stony silt
loams, steep phases—are recognized. The areas of these stony soils are so closely associated that it is not practicable to separate them on the soil map. The soils have profiles similar to those of Frederick silt loam and Elliber silt loam and are characterized by the presence of small limestone bedrock outcrops, which occupy from about 15 to 35 percent of the surface.

An area of Clarksville cherty silt loam, northeast of Hansonville in a cultivated field, shows the following profile:

A. 0 to 2 inches, grayish-brown light silt loam containing a small quantity of organic matter derived from decayed leaves, twigs, and grass.
B. 2 to 10 inches, light grayish-yellow or light yellowish-gray friable silt loam.
C. 10 to 37 inches, light brownish-yellow friable silty clay loam in which are small spots of rust brown and ochaceous yellow.
D. 37 to 45 inches, finely mangled brown, rust-brown, ochaceous-yellow, and very light gray friable partly decomposed chert containing small black mineral particles.
E. 45 to 55 inches, mangled brown, ochaceous-yellow, dark reddish-brown, and very light gray friable silty clay derived from decomposed chert and probably decomposed shale. Small black mineral particles and black mineral films appear in the material. This material has a smooth or greasy feel.

Scattered over the surface and mixed with the soil are a great many angular chert fragments, about 1/8 to 3 inches in diameter, which give the soil a distinctly cherty appearance. These chert fragments compose about 35 to 50 percent of the soil. The chert is dark gray on the fresh surface and light gray or brownish yellow on the weathered surface.

This soil is underlain by limestone at a depth of about 5 to 15 feet or considerably more. The limestone contains much chert near the place where it outcrops, and the chert is possibly the result of epigenetic processes.

The following members of the Clarksville series are also mapped: Clarksville cherty silt loam, hilly phase; Clarksville cherty silt loam, steep phase; Clarksville cherty fine sandy loam; Clarksville cherty fine sandy loam, hilly phase; and Clarksville cherty fine sandy loam, steep phase. Clarksville cherty fine sandy loam is similar to Clarksville cherty silt loam except that it has a slightly coarser texture and contains a few sandstone fragments. The fine sandy loam texture of this soil is explained by the presence of thin beds of quartz sandstone in the parent rock. When the sandstone breaks down through weathering, fine sand is added to the soil material.

Lodi loam, occupying an area about 1 mile northwest of Bolton in a pasture, has a profile as follows:

A. 0 to 6 inches, brown mellow loam, light brown when dry.
B. 6 to 12 inches, mangled light yellowish-brown and dark reddish-brown friable heavy loam or very fine sandy clay.
C. 12 to 37 inches, yellow-brown friable rather firm silty clay loam containing an appreciable quantity of very fine sand. A few small dark reddish-brown spots appear in the soil. The soil breaks into irregular lumps, about 1 inch to 2 inches in diameter, which with slight pressure break into small angular particles.
D. 37 to 45 inches, light-brown friable silty clay loam containing small spots of ochaceous yellow. This material breaks into angular lumps, 1 to 2 inches in diameter, that have a dark reddish-brown coating on the cleavage planes.
A few small light-gray chert fragments are on the surface and in the soil, and a few small pieces of brown sandstone are on the surface. The soil is underlain at a depth of 45 to 80 inches, or considerably more, by quartz sandstone.

Lodi loam, hilly phase, and Lodi loam, steep phase, are also recognized in the county. These soils differ from Lodi loam mainly in the character of the relief they occupy and also in having slightly thinner soil layers in many places.

An area of Bolton loam, about 1 mile northeast of High Point School, in grassland, has a profile described as follows:

A. 0 to 8 inches, brown mellow loam, apparently containing a considerable amount of organic residue and a few small black mineral concretions. The soil is very dark brown when wet.

B. 8 to 34 inches, mingled brown and light yellowish-brown friable crumbly heavy loam or fine sandy clay containing a great many small black mineral concretions. A cut surface of the soil is yellowish brown, streaked very dark brown or black by mashed mineral concretions.

C. 34 to 45 inches, mingled dark reddish-brown, brown, and yellowish-brown friable silty clay loam, in which are present many black mineral particles ranging from about birdshot to buckshot in size. The soil is slightly reddish brown on the cut surfaces. Partly decomposed chert fragments are mixed with the soil material, and the color of these fragments may be almost black or almost white. A few small gray chert and brown sandstone fragments are on the surface and in the solum. Some small pieces of mineral, probably limonite, appear on the surface of the soil in some places.

Bolton loam, rolling phase, and Bolton loam, steep phase, are also mapped.

Carbo silty clay loam, occurring about 1 1/2 miles east of Lebanon in a pasture, has the following profile:

A. 0 to 5 inches, slightly grayish brown silty clay loam. A small quantity of well-decomposed organic matter appears to be mixed with the mineral soil.

B. 5 to 12 inches, finely mingled ochreous-yellow and brown heavy slightly plastic silty clay loam, which breaks into angular lumps 1 to 2 inches in diameter. A brown coating appears on the breakage planes of these fragments. A cut surface of the material is yellowish brown.

B. 12 to 22 inches, mingled reddish-brown and ochreous-yellow heavy plastic silty clay, which breaks into irregularly shaped lumps 2 to 4 inches in diameter. The breakage planes of the lumps are coated with dark reddish brown. A cut surface of the clay is yellowish brown or reddish brown.

C. 22 to 32 inches, ochreous-yellow friable silty clay loam containing soft decomposed light greenish-yellow shale. A brown mineral film appears on the breakage planes in this material.

At a depth of 32 to 35 inches the soil is underlain by laminated fossiliferous limestone, platy limestone, massive limestone, or argillaceous limestone, and in places thin beds of light-green shale.

Carbo silty clay loam, rolling phase, and Carbo silty clay loam, steep phase, are mapped in association with areas of Carbo silty clay loam.

An area of Bland silty clay loam, about 2 miles west of Lebanon in a pasture, shows the following profile:

A. 0 to 2 inches, dark purplish-brown heavy silt loam, apparently having a fair content of decomposed organic matter. The soil is light grayish brown when dry.

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A. 2 to 6 inches, dark grayish-brown silty clay loam, which breaks into angular aggregates about 3/8 to 3/4 of an inch in diameter. When dry the soil is light grayish brown with a purple hue.

B. 6 to 26 inches, dark purplish-brown plastic silty clay containing many black mineral specks. The purple of this soil is more pronounced on a cut surface than on a broken surface. The soil breaks readily into angular particles about 1/2 to 1 inch in diameter, and the particles are hard and rather difficult to crush.

C. 26 to 34 inches, dark purplish-brown friable slick silty clay loam intermixed with small pieces of dark-brown decomposed shale, which are coated black on the cleavage planes. The material breaks into angular particles about 1/2 to about 1 inch in diameter, and these particles are finely mingled dark brown, rust brown, and dark purple on the inside.

At a depth of about 35 to 40 inches the soil rests on interbedded purplish-brown, purplish-red, and dark-gray limestone. The purplish-brown and purplish-red limestone on weathering changes to a brown rock that has the appearance of shale. The dark-gray limestone weathers to light gray or light yellow.

In addition to Bland silty clay loam, three soils of the same series are mapped, namely, Bland silty clay loam, rolling phase; Bland stony silty clay loam; and Bland stony silty clay loam, steep phase. Bland stony silty clay loam is similar in profile development to Bland silty clay loam and is separated from that soil because of the presence of small outcrops of limestone bedrock, which occupy from about 15 to 40 percent of the surface.

An area of Wellston loam, northeast of Swords Creek in a pasture, has the following profile:

A. 0 to 2 inches, brown mellow loam containing a moderate amount of organic matter derived from decayed grass and leaves. A few small light-gray sandstone fragments are on the surface.

B. 2 to 9 inches, yellowish-brown mellow loam, which, when dry, is very light brown or light grayish brown.

C. 9 to 28 inches, brownish-yellow friable heavy loam or fine sandy clay, which breaks into angular soil particles about 3/8 to 3/4 of an inch in diameter. The particles may be easily crushed into a soft mass devoid of structure. A few small partly decomposed brown sandstone and shale particles are present in the soil.

C. 28 to 45 inches, mingled ochreous-yellow, brown, and dark reddish-brown friable crumbly silty clay loam, intermixed with partly decomposed brown sandstone and dark-green shale.

C. 45 inches +, bedrock consisting of gray medium-textured sandstone, green sandstone, dark-green shale, and black shale. The gray sandstone, apparently contains fine mica scales and small feldspar particles.

Wellston loam, hilly phase, is also mapped, and it differs from typical Wellston loam mainly in having steeper relief.

The poorly or immaturely developed zonal soils include Westmoreland silty clay loam, Westmoreland silt loam, Upshur-Litz silt loams, Muskingum loam, Muskingum very fine sandy loam, Lehew very fine sandy loam, Hayter loam, Jefferson fine sandy loam, Emory silt loam, Greendale silt loam, and Sequatchie loam.

These soils do not have mature or well-developed profile characteristics, because of the character of their parent material, their relief, or their age; although they do have some of the zonal soil characteristics. The relief of some of these soils varies considerably, and it is necessary to map phases of the types, based on the character of the relief. Hence, rolling, hilly, steep, or very steep phases are recognized. The differences in the slopes that distinguish these phases
have produced slight differences in the thickness of the soil layers in places and perhaps slight differences in the character of the soils. The resultant differences in the soils, however, are not sufficient to cause the phases to be classed in other soil series.

An area of Westmoreland silty clay loam, about 2 miles north of Old Rosedale in a pasture, shows the following profile:

A. 0 to 5 inches, grayish-brown silty clay loam, which breaks into medium-to fine-granular particles. A considerable amount of well-decomposed organic matter is apparently incorporated with the mineral material of this layer.

B. 5 to 12 inches, yellowish-brown heavy silty clay loam, which breaks readily into soil particles ranging from about 1/8 to 1/4 of an inch in diameter. These particles are finely mingled dark reddish brown and ocherous yellow on the inside and are coated with brown on the outside.

Bb. 12 to 24 inches, light yellowish-brown slightly tenacious silty clay loam, which breaks easily into angular soil particles about 1/4 to 1/2 of an inch in diameter. These particles are finely mingled dark reddish brown and ocherous yellow on the inside and are coated with brown on the outside. A few small black mineral specks are present in the soil mass.

C. 24 to 30 inches, mingled or mottled ocherous-yellow, brown, and dark reddish-brown friable silty clay loam mixed with soft yellowish-brown shale fragments. A few fine black mineral particles are present in this material.

The Westmoreland soils are underlain by bedrock at a depth of about 24 to 40 inches. The bedrock consists of limestone and shale in alternate beds, and the limestone composes a slightly greater proportion of the bedrock than the shale.

Other Westmoreland soils mapped are Westmoreland silty clay loam, hilly phase; Westmoreland silty clay loam, very steep phase; Westmoreland silt loam; Westmoreland silt loam, rolling phase; and Westmoreland silt loam, very steep phase. Westmoreland silt loam differs from Westmoreland silty clay loam mainly in texture, although the limestone formation underlying it contains a smaller proportion of limestone in most places than the formation underlying Westmoreland silty clay loam.

Upshur-Litz silt loams is a complex of two soils—Upshur silt loam and Litz silt loam. Individual areas of each of these soils are so closely associated and so small that it is not feasible to separate them in mapping. Upshur silt loam has a 6-inch purplish-brown or grayish-brown friable silt loam surface soil and a 9- to 12-inch purplish-brown or purplish-red firm friable silty clay subsoil, underlain by decomposed purplish-red shale. Litz silt loam has a 6-inch brown or light-brown friable silt loam surface soil and a 6- to 9-inch light-brown firm but friable silty clay loam subsoil, underlain by parent material composed of brown and light-brown soft decomposed shale mixed with a small quantity of light-brown silty clay loam. These two soils have formed from the decomposed material of a mixed rock formation consisting of purplish-red or red shale, greenish-gray shale, and some limestone. The color of each of these soils appears to be inherited from the color of the parent rock.

Other Upshur-Litz soils mapped are Upshur-Litz silt loams, steep phases. These soils differ from the typical soils mainly in having steeper relief.

Muskingum loam resembles Wellston loam, except that it occurs on steeper slopes and the soil layers are not so well formed. In addition, Muskingum loam, very steep phase, is mapped.
The 6- to 8-inch surface soil of Muskingum very fine sandy loam consists of light brownish-yellow or light grayish-yellow friable very fine sandy loam, and the 16- to 18-inch subsoil consists of light-brown or yellowish-brown friable very fine sandy clay. The subsoil grades into parent material consisting of brown, reddish-brown, and ocherous-yellow soft friable fine sandy clay mixed with ocherous-yellow, reddish-brown, and very light gray decomposed sandstone. In forested areas a thin layer of leafmold rests on the surface of the soil, and a small quantity of dark grayish-brown organic matter, derived from decayed leaves and twigs, is mixed with the first inch or two of the surface soil. A few light-gray sandstone fragments, ranging from 4 to 10 inches in diameter, are on the surface and in the soil.

In addition to Muskingum very fine sandy loam, Muskingum very fine sandy loam, hilly phase, is mapped. The latter soil differs from the former mainly in occupying gentler slopes.

Lehew very fine sandy loam has a 6- or 7-inch surface soil of brown or purplish-brown friable very fine sandy loam and a subsoil of light purplish-brown or purplish-red friable crumbly very fine sandy clay, which ranges from about 18 to 24 inches in thickness. The parent material is composed of purplish-red fine sandy clay mixed with soft decomposed purplish-red sandstone and shale. In forested areas, a thin layer of grayish-brown leafmold is on the surface and a small quantity of grayish-brown organic matter, derived from decayed leaves and twigs, is mixed with the topmost inch or so of the surface soil. A few small fragments of shale and sandstone are on the surface and in the soil layers. The slope ranges from about 15 to 60 percent and in some places considerably more. The parent rock, which is noncalcareous in most places, consists of purplish-red shale and sandstone, the color of which is imparted to the soil.

An area of Hayter loam, about 1 mile east of Old Rosedale in a cultivated field, has a profile as follows:

A. 0 to 12 inches, brown mellow loam, apparently containing a fairly large quantity of organic residue, which is well incorporated with the mineral soil. When dry, the soil is light brown. A few small brown sandstone fragments are on the surface.
B. 12 to 30 inches, light-brown friable slightly plastic silty clay loam or silty clay containing a few black mineral specks.
C. 30 to 42 inches, light-brown friable silty clay loam material mixed with purplish-red and ocherous-yellow soft decayed shale particles and decomposed small fragments of brown sandstone. A few small black mineral particles are present.

Hayter loam, hill phase, is also mapped, and this soil differs from the Hayter loam mainly in having a steeper slope.

In a cultivated field Jefferson fine sandy loam has the following profile:

A. 0 to 7 inches, grayish-brown friable fine sandy loam, which, when dry, is light grayish yellow or light gray.
B. 7 to 28 inches, light brownish-yellow or yellowish-brown friable fine sandy clay.
C. 28 to 40 inches, mixed brownish-yellow and ocherous-yellow friable fine sandy clay or loamy fine sand containing a mixture of light-yellow and almost white decayed sandstone fragments.

A few angular and subangular brown and light-gray sandstone fragments, ranging from about 4 to 8 inches in diameter, are on the surface and in the solum. The parent material of this soil consists
of weathered light-brown sandstone fragments and other rock waste moved by gravity from mountain slopes and deposited on valley floors. In some places purplish-brown sandstone fragments and soft yellowish-brown shale fragments are mixed with this rock waste.

Jefferson fine sandy loam, hill phase, is also mapped. It differs from typical Jefferson fine sandy loam mainly in occupying steeper slopes.

A profile of Emory silt loam, about 1 mile east of Lebanon in a cultivated field, is described as follows:

A. 0 to 18 inches, brown mellow silt loam, apparently containing a fairly large quantity of well-decomposed organic matter thoroughly mixed with the mineral soil. The soil is dark brown when wet.

B. 18 to 32 inches, light-brown friable silty clay loam, in which are a few black mineral specks.

C. 32 to 42 inches, light-brown or brown friable silty clay loam material containing many small black mineral particles, which increase in size and number with depth.

This soil has formed from creep and rainwash material derived from slopes underlain by limestone and occupied by soils of the Hagerstown series. In addition, Emory silt loam, slope phase, is mapped. This slope phase differs from Emory silt loam mainly in having a steeper slope.

Greendale silt loam, located about 1 mile northwest of Cross Roads in cultivated land, has the following profile:

A. 0 to 10 inches, light grayish-yellow friable silt loam, apparently containing very little organic matter.

B. 10 to 32 inches, brownish-yellow or finely mingled yellow and light-brown friable silty clay loam, which breaks readily into angular particles about \( \frac{1}{4} \) to 1 inch in diameter.

C. 32 to 40 inches, brownish-yellow friable compact silty clay mottled with rust brown, ocherous yellow, and very light gray. A few small black mineral particles are present in this material.

This soil has developed near the base of slopes from creep and rainwash moved from soils of the Clarksville, Dunmore, Lodi, and Westmoreland series. In some places many small light-gray chert fragments are on the surface and in the soil mass. These fragments were derived from nearby cherty slopes.

Greendale silt loam, slope phase, is separated on the soil map from typical Greendale silt loam, mainly on the basis of steeper slope.

A profile of Sequatchie loam in a cultivated field is described as follows:

A. 0 to 10 inches, brown mellow loam, apparently containing a fairly large quantity of organic residue.

B. 10 to 30 inches, faintly yellowish brown friable slightly plastic silty clay loam containing a few small black mineral particles.

C. 30 to 40 inches, mottled brown and ocherous-yellow friable silty clay loam mixed with soft decomposed pieces of purple shale and brown sandstone. A small number of black mineral specks are in this material.

Sequatchie loam has formed on low terraces or high bottoms near streams from material that was washed from slopes underlain by sandstone and shale and some limestone and deposited near streams by running water.

Sequatchie loam, slope phase, differs from typical Sequatchie loam mainly in having a steeper slope.

An area of Holston loam, near Castlewood in a cultivated field, has a profile as follows:
A. 0 to 8 inches, brownish-yellow friable loam, which is light grayish brown when dry.

B. 8 to 32 inches, mingled brownish-yellow and yellowish-brown friable fine sandy clay, which may be easily crushed to a light brownish-yellow or yellow soft mass having no definite structure.

C. 32 to 40 inches, brownish-yellow compact fine sandy clay mottled with ocherous yellow, rust brown, and very light gray. This material can be easily crushed to a soft crumbly mass that has no definite structure. A few black mineral specks and films are present.

Holston loam has developed on terraces from alluvial material derived from upland slopes underlain mainly by noncalcareous sandstone and shale.

Holston loam, slope phase, also mapped, differs from typical Holston loam mainly in having a stronger slope.

Tumbez silty clay loam and Tumbez silty clay loam, rolling phase, are intrazonal soils. They appear to be Rendzinas, as small fragments of decomposed calcareous parent rock are present in the soil layers and give these layers an alkaline reaction. The surface soil of Tumbez silty clay loam ranges from about 8 to 12 inches in thickness and consists of dark-gray silty clay loam or silty clay containing almost white decomposed limestone particles. The subsoil, which ranges from about 3 to 15 inches in thickness, is dark-gray somewhat plastic silty clay mixed with nearly white small decomposed limestone fragments. The parent material consists of nearly white decomposed limestone. In some places no subsoil layer has developed and the surface layer passes directly into the parent material.

Burgin silty clay loam apparently is an imperfectly drained intrazonal soil. In an area south of Hansonville, in a cultivated field, it has the following profile:

A. 0 to 12 inches, very dark brown or almost black heavy plastic silty clay loam containing a comparatively large quantity of organic residue. Small spots of rust brown are present in the soil. When dry the soil is gray and breaks into large angular lumps. The surface presents a network of cracks.

B. 12 to 32 inches, finely mingled, brown, ocherous-yellow, and very light gray tough plastic silty clay, which, on drying, cracks and breaks into angular aggregates about 1/4 to 1 inch in diameter. The outsides of the aggregates are coated with dark-brown material. The cut surface of this silty clay is light brown. Some black mineral specks are present.

This soil has formed at the base of slopes underlain by limestone from creep and rainwash derived from soils of the Carbo, Bland, and Westmoreland series.

Burgin silty clay loam, slope phase, is also mapped. This soil is similar to Burgin silty clay loam in characteristics and differs from that soil mainly in the stronger slopes it occupies.

The azonal soils include Lithosols and alluvial soils that lack definite genetic horizons.

Many Lithosols occur in the county and include the following soils: Rolling stony land (limestone material); rough stony land (limestone material); Upshur-Litz shaly silt loams; Upshur-Litz shaly silt loams, steep phases; Litz shaly silt loam; Litz shaly silt loam, hilly phase; Muskingum stony loam; Muskingum stony very fine sandy loam; Montevallo shaly silt loam; rough stony land (Muskingum soil material).

Each of these soils lacks uniformity in texture, structure, and consistency and also lacks clearly defined soil layers. The soils are com-
posed of partly weathered disintegrated shale or sandstone in place or partly weathered sandstone and shale fragments that have accumulated near the foot of mountain slopes. Rolling stony land (limestone material) and rough stony land (limestone material) consist of limestone material in which small outcrops of limestone bedrock occupy from about 40 to 90 percent of the surface. Soil has had very little opportunity to develop from the limestone material among the many rock outcrops.

Rock outcrop consists of bare exposures of bedrock, mainly sandstone. A few stunted trees and a few bushes and shrubs grow on the rock outcrops in places where a small amount of soil material has accumulated.

The alluvial soils of the first bottoms are partly azonal and partly intrazonal. Two soil catenae are present in first bottoms; one of these includes soils of the Huntington, Lindside, and Melvin series; and the other, soils of the Pope, Philo, and Atkins series. In these catenae the Huntington and Pope soils are the well-drained azonal soils, the Lindside and Philo soils are the imperfectly drained soils—azonal or intrazonal—and the Melvin and Atkins soils are poorly drained intrazonal soils. The soils of each catena are developed from parent materials that are practically the same in character, and the soils owe their differences mainly to the state of their internal drainage.

Following are detailed descriptions of profiles of Huntington silt loam, Lindside silt loam, Melvin silty clay loam, and Pope fine sandy loam.

A profile of Huntington silt loam, observed near Indian Creek about 1 1/2 miles northeast of Belfast Mills in a cultivated field, is described as follows:

1. 0 to 18 inches, brown mellow silt loam containing a few small rust-brown spots. A fairly large quantity of decomposed organic matter seems to be incorporated with the mineral soil.
2. 18 to 32 inches, light-brown friable silty clay loam containing a few black mineral specks. This material crushes easily to a soft friable structureless mass.
3. 32 to 42 inches, light-brown sticky fine sandy clay. A few small black concretions and a few small brownish-yellow calcium carbonate concretions are present.

This soil has formed in first bottoms near streams from alluvial material derived from slopes of the uplands underlain by limestone. It has good external and internal drainage.

Lindside silt loam, occurring about 2 miles east of Lebanon in a pasture, has the following profile:

1. 0 to 12 inches, light-brown friable silt loam.
2. 12 to 28 inches, mingled light grayish-brown and rust-brown friable slightly plastic silty clay loam containing small specks and some films of black mineral matter.
3. 28 to 36 inches, light-gray somewhat plastic silty clay loam containing small spots of rust brown and ocherous yellow. Brown fibrous vegetable matter, black mineral specks, and thin dark-brown shale particles are present in the material. At a depth of about 36 to 40 inches this material is underlain by limestone and chert fragments about 1 to 3 inches in diameter.

This soil is developed in first bottoms from alluvial material derived from slopes of the uplands underlain by limestone. The soil has fairly good drainage in the A horizon and imperfect drainage in the B and C horizons.
An area of Melvin silty clay loam, about 1½ miles east of Lebanon in a pasture, shows the following profile:

1. 0 to 8 inches, gray silty clay loam having a few small spots of rust brown. The soil is light gray or very light gray when dry.
2. 8 to 24 inches, gray or light gray plastic silty clay containing small rust-brown spots.
3. 24 to 40 inches, light-gray heavy very plastic silty clay or clay containing spots of rust brown, which become larger with depth. A few small fragments of chert and particles of sand are present in the lower part of the layer.

Melvin silty clay loam has formed in first bottoms near streams from alluvial material derived from slopes of the uplands underlain by limestone. The soil is poorly drained on the surface and throughout the soil.

Along the Clinch River near Castlewood in a cultivated field, a profile of Pope fine sandy loam may be described as follows:

1. 0 to 18 inches, brown mellow fine sandy loam that seems to contain a fair quantity of well-decomposed organic matter. The soil is light brown when dry.
2. 18 to 35 inches, light-brown or finely mingled light-brown and brown friable crumbly fine sandy loam.
3. 35 to 40 inches, light-brown loose sandy loam or loamy sand, containing brownish-yellow sandstone and quartzite gravel, the individual pieces of which range from about 1 to 3 inches in diameter.

Pope fine sandy loam has developed in first bottoms near streams from alluvial material consisting of sand, silt, and clay. This material was washed from slopes of the uplands underlain by noncalcareous sandstone and shale and deposited near streams by running water.

In addition to Pope fine sandy loam, Pope sandy loam is mapped. This soil differs from Pope fine sandy loam mainly in being coarser textured, looser, and more friable.

To a depth of about 10 inches Philo fine sandy loam is grayish-brown or light-brown fine sandy loam. Below this layer mottled gray and rust-brown friable sticky fine sandy clay extends to a depth of about 28 inches, where it passes into light-gray slightly plastic fine sandy clay containing small spots and specks of rust brown and ocherous yellow.

Atkins fine sandy loam is imperfectly or poorly drained on the surface and throughout the soil. The surface layer of this soil is gray or dark-gray slightly plastic fine sandy loam containing small yellowish-brown or rust-brown spots. At a depth of about 6 inches this material passes into gray or mottled gray and brown heavy plastic fine sandy clay or silty clay, which at a depth of about 28 inches gives way to heavier textured and somewhat more plastic soil material.

Alluvial soils, undifferentiated, are miscellaneous soils appearing in first bottoms, and the land is poorly drained in some places. Rainwash has been deposited on the soil in places.

LABORATORY DETERMINATIONS

Table 9 gives the results of pH determinations of samples of two soils from Russell County.
Table 9.—pH determinations of samples of two soils from Russell County, Va.\(^1\)

<table>
<thead>
<tr>
<th>Soil type and sample No.</th>
<th>Depth</th>
<th>pH</th>
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<td>Hagerstown silt loam, rolling phase:</td>
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<td>212001</td>
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<td>212005</td>
<td>42-48</td>
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<td>Piggah silt loam:</td>
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<tr>
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\(^1\)Determinations made by P. H. Bailey, Division of Soil Survey, Assistant Soil Technologist, Bureau of Plant Industry, by the hydrogen-electrode method.

The mechanical analyses of two soils are given in Table 10.

Table 10.—Mechanical analyses of samples of two soils from Russell County, Va.

<table>
<thead>
<tr>
<th>Soil type and sample No.</th>
<th>Depth</th>
<th>Fine gravel</th>
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<th>Fine sand</th>
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**SUMMARY**

Russell County is in the southwestern part of Virginia. The county lies within the Valley and Ridge physiographic province.

The general surface features are those of a broad lowland belt, bordered on either side by comparatively high mountains and plateau country. The lowland belt extends in a northeast-southwest direction and consists of alternate valleys and ridges. The valley floors range in elevation above sea level from about 1,400 to about 2,600 feet. The ridges for the most part have narrow crests. The relief in the valleys ranges from rolling to hilly, although much steep country has developed near some of the streams and near the summits of the ridges in many places. Areas having almost level to undulating surfaces and ranging from a few feet to nearly half a mile in width occur as terraces and first bottoms along some of the streams.

The northeastern and northwestern parts of the county have been dissected by numerous streams, which have cut narrow valleys separated by steep ridges. The northern county line in most places follows a ridge that ranges in elevation above sea level from about 2,400 to 3,735 feet. The southern county line follows a well-defined mountain ridge ranging in elevation from about 3,000 to more than 4,000 feet. Beartown Mountain, situated in the southeastern part, is the highest point in the county, reaching an altitude of 4,604 feet.

The uplands are well drained throughout, and the only poorly drained areas in the county are in low flat places near some of the streams.

A large part of the mountainous country and much of the steep country in the lowland belt are covered with forest. Practically all of the merchantable timber has been removed, and the remaining forests are composed of second-growth trees.
Originally the county was practically covered with forest. Removal of the virgin timber started when the pioneers began to deaden the trees and clear the land for crops and pasture. In the mountainous parts the forests were not exploited until the advent of the railroad about 1880.

Much mountain timber was used in connection with coal-mining operations. Only a few sawmills are now in use, and these operate mainly in the mountainous districts.

Russell County was formed from a part of Washington County in 1786. During subsequent years much of the territory of Russell County was taken in the formation of other counties, and the county was finally reduced to its present size in 1880.

The early settlers were of Scotch-Irish descent, and the present population is composed largely of their descendants. According to the 1940 census, the population of the county was 26,627.

The county has no large towns. According to the 1940 census, Lebanon, the county seat, has a population of 662. Dante, the largest town, having a population of approximately 2,600, is located in a coal-mining district in the northwestern part of the county.

The northern part of the county is served by railroad lines, but the southern part has no railroad facilities. Hard-surfaced highways extend into nearly all parts. Secondary highways, constructed of soil, gravel, or sand-clay, traverse practically all of the districts between the main highways. Churches and schools are located at convenient places throughout the county.

Coal mining began about 1904 and soon became an important industry. In 1929, 1,414,677 tons of coal was mined, but in 1935 the output was only 660,424 tons. Although coal is the main mineral resource, other minerals are present in small quantities. At present none of these other minerals is mined, although some of the mines have been worked in the past.

The climate of the county is continental, and there is a considerable variation in seasonal temperatures. The mean annual temperature is 54.5° F. Outdoor work can be performed during the winter except on a few extremely cold days. Oats are sown mostly in the spring. Wheat grown on northerly exposed slopes is injured by freezes. The grazing season extends from about April 15 to November 15. The average frost-free season is 178 days. The average annual rainfall is 50.82 inches and is ample for the needs of the crops commonly grown.

The early agriculture was diversified and practically self-sustaining. The census of 1850 shows that the agriculture consisted of growing corn, wheat, and oats and raising livestock. In addition, some rye, buckwheat, tobacco, peas, beans, potatoes, butter, cheese, clover seed, hay, flax fiber, flaxseed, maple sugar, molasses, honey, beeswax, and wool were a part of the agricultural products. Bluegrass has been one of the main pasture plants since the early days of agriculture.

Agriculture is well balanced and consists in the growing of corn, hay, and wheat as the leading subsistence crops and in the raising of cattle and sheep for a cash income. Oats, barley, and rye are grown in a small way. Burley tobacco is produced on a large number of farms as a cash crop.
Some dairy products are sold for cash. Hogs are raised for a home supply of pork. Potatoes and sweetpotatoes are grown on some farms for home use. Nearly every farm has a vegetable garden and a small apple orchard to supply home needs of vegetables and apples. A small cash revenue is gained by some of the people through the sale of forest products.

Bluegrass grows well on many of the soils and contributes much to the pasturage of the county. Other pasture plants are volunteer clover, lespedeza, orchard grass, and timothy. Clover and timothy are the main hay plants, and these make good yields of hay on many of the soils.

According to the 1940 census, 64.3 percent of the farms reported the purchase of fertilizer, at an average expense of $32.09 per farm reporting. Stable manure is applied to the land in such quantities as are available.

Farm labor is plentiful and fairly efficient. Practically all of the farm laborers are white. According to the 1940 census, 83.1 percent of the total area of the county is in farms. The average size of farms is 90.5 acres. Tenancy is comparatively low, and according to the 1940 census 67.3 percent of the farms were operated by the owners, 32.6 percent by tenants, and 0.1 percent by managers. A large percentage of the tenants work on a crop-sharing basis.

The work animals are chiefly horses, consisting mainly of grade Belgians and Percherons. The beef cattle are predominately Hereford and Shorthorn. The sheep are mostly Hampshire and Southdown, and the hogs are chiefly Poland China.

The underlying rocks of Russell County are sedimentary in origin and consist of limestone, shale, and sandstone. Limestone and interbedded limestone and shale are the predominant rocks in the lowland belt. In the northeastern, northwestern, and southeastern parts, sandstone and shale are the main rocks. From soft weathered rock material many soils, which differ in physical and chemical composition, have developed. In addition to the material derived from the bedrock, many other soils have developed from colluvial material at the base of slopes and in depressions and from alluvial material deposited near streams.

Owing to their unequal resistance to the forces of weathering and erosion, the different rocks have given rise to a varied relief that ranges from smooth and hilly to steep and broken.

In general, the soil is composed of a light- to heavy-textured surface soil and a subsoil that contains more clay than the surface soil and varies from friable and brittle to tough and plastic. Below the subsoil is a layer of friable or crumbly decomposed rock material. The soils developed over shale and sandstone are in most places not so deep as those developed over limestone.

Most of the soils are slightly to strongly acid in reaction. Many soils on the uplands do not contain a very large quantity of organic matter. The brown soils developed from alluvial material near streams and those formed from colluvial material near the bases of slopes and in depressions contain a fair quantity of organic matter in the surface soil.

In order to show the relation of the various soils to the agriculture of the county, the soils are grouped into First-class, Second-class, Third-class, Fourth-class, and Fifth-class soils.
The First-class soils have a total area of about 14.6 square miles. They have comparatively high productivity, are otherwise favorable for cultivation, and are used extensively in the production of corn, wheat, and hay. A small part of some of the soils is in pasture. Some areas are planted to tobacco. The relief ranges from almost level to rolling.

The Second-class soils have a total area of about 33.7 square miles and are distributed in the lowland belt of the county. The relief ranges from nearly level to hilly and in some places is steep. With the exception of a few flat areas in first bottoms, all these are well drained. The soils of the uplands in this group are underlain mostly by limestone. Soils are placed in this group rather than with the First-class soils because of one or more less favorable characteristics, such as steeper slopes, the presence of chert, lower fertility, less depth, heavier and less pervious subsoil, or less favorable moisture conditions. A considerable area of most of the soils is planted to corn, hay, and wheat. Some areas are used for the production of tobacco. A fairly large total area is in pasture. In general, the crop yields are not so good as those obtained on the First-class soils.

The Third-class soils include a total of about 54 square miles. These soils have developed mainly in the lowland belt and are largely underlain by limestone. In places limestone and shale in alternate beds underlie rather large areas of soil. In some formations sandstone is present in the limestone. A few of the soils have developed from colluvial material, and a few others from alluvial material. Hilly or steep relief, an abundance of chert fragments, and the source of parent material are conditions that determine the place in which these soils belong in the agriculture. The soils are used in the production of corn, hay, and wheat. Tobacco is grown in a small way on some of the soils, and some areas are used for pasture. On the whole, crop yields are lower than on the Second-class soils.

The Fourth-class soils comprise a total area of approximately 157.7 square miles. They are distributed in the lowland belt and to some extent on mountain slopes. Much of the relief is steep. Some areas are undulating, rolling, or hilly, but the presence of stones render the soils undesirable or unfit for cultivation. The Fourth-class soils developed in first bottoms are poorly drained and in their present condition are not suited to the growing of crops. A small part of some of the Fourth-class soils is used for the production of crops, but, because of steepness of slope, stoniness, or poor drainage conditions, ordinarily the soils are more useful as pasture land.

The Fifth-class soils have a total area of about 212 square miles. A large part of these soils has a slope ranging from 60 to 80 percent or somewhat more. Some of the soils are comparatively shallow, and many others have rock fragments on the surface and in the soil. In some places the relief is broken and rough. Because of the steepness of slope, the roughness of relief, the presence of rock fragments and rock outcrops, or the naturally impoverished condition of the soil, these soils are undesirable or unfit for crops or pasture, although small areas of some of them are used as cropland and pasture land. The best use for the Fifth-class soils is for forestry.
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