SOIL SURVEY

Scott County
Virginia

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and Agricultural Engineering
In cooperation with the
VIRGINIA AGRICULTURAL EXPERIMENT STATION
and the
TENNESSEE VALLEY AUTHORITY
Farmers who have lived in one locality
for a long time come to know about
the soil differences on their own farms and
on those of their immediate neighbors.
What they do not know, unless a soil survey
has been made, is how nearly their soils
are like those at experiment stations or in
other localities from which higher yields
are reported. They do not know whether
these higher yields are from soils like their
own or so different that they could not
hope to get equally high returns, even if
they adopted the practices followed in these
other places. These similarities and differen-
tes are known only after a map of
the soils has been made. Knowing what
kind of soil one has and comparing it with
soils on which new developments have
proved successful will remove some of the
risk in trying new methods and varieties.

Soils of a particular farm
To find what soils are on any farm or
other tract of land, locate it on the soil
map, which is in the envelope inside the
back cover. This is easily done by finding
the section the farm is known to be in and
locating its boundaries by such landmarks
as roads, streams, villages, and other
features.

Each kind of soil is marked with a
symbol on the map; for example, all soils
marked Gs are of the same kind. To find
the name of the soils so marked, look at
the legend printed near the margin of the
map and find Gs. The color where Gs
appears in the legend will be the same as
where it appears on the map. The Gs
means Greendale silt loam. A section of
this report (see table of contents) tells
what Greendale silt loam is like, for what
it is mainly used, and some of the other
uses to which it is suited.

How productive is Greendale silt loam?
Find this soil name in the left-hand column
of table 10, and note the yields of the dif-
ferent crops opposite it. This table also
gives expectable yields for all the other
soils mapped, so that the different soils can
be compared.

Read in the section on Soil Series, Types,
and Phases to learn what are good uses
and management practices for this soil.
Look also at the section headed Use, Man-
agement, and Productivity.

Soils of the county as a whole
If a general idea of the soils of the
county is wanted, read the introductory
part of the section on Soils. This tells
where the principal kinds are found, what
they are like, and how they are related to
one another. Then study the soil map and
notice how the different kinds of soils tend
to be arranged in different localities.
These patterns are likely to be associated
with well-recognized differences in type of
farming and land use.

A newcomer who considers purchasing
a farm in the county will want to know
about the climate as well as the soils; the
principal farm products and how they are
marketed; the types and sizes of farms;
the kinds and conditions of farm tenure;
kinds of farm equipment and machinery;
availability of schools, churches, highways,
railroads, telephone and electric services,
and water supplies; the location of cities
and villages; and about industries and
population characteristics. This informa-
tion will be found in the sections on General
Nature of the Area and on Agriculture.

Students and others interested in how
the soils of the county were formed and
how they are related to the great soil
groups of the world should read the section
on Morphology and Genesis of Soils.

This publication on the soil survey of Scott County, Va., is a cooperative contribution from the-

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TENNESSEE VALLEY AUTHORITY
# SOIL SURVEY OF SCOTT COUNTY, VIRGINIA


Area inspected by J. W. MOON, Principal Soil Scientist, Division of Soil Survey.

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.
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SCOTT COUNTY, VIRGINIA, lying in one of the narrowest parts of the Great Valley of Virginia, was settled by many of the pioneers who traveled the old Wilderness Road. About 50 percent of its area is in forest, mainly of second-growth trees. Much of the soil is underlain by limestone, some of which is used in the manufacture of portland cement, and coal and natural gas are present. The county, however, is mainly agricultural and grain and hay are the principal crops. Tobacco is grown on a comparatively large total acreage. Livestock and livestock products are important in the agriculture. The farming districts and the principal towns are adequately served by railroads and public highways. To provide a basis for the best agricultural uses of the land cooperative soil research and mapping of the soils was made by the United States Department of Agriculture, the Virginia Agricultural Experiment Station, and the Tennessee Valley Authority. The results may be summarized as follows.

**SUMMARY OF THE SURVEY**

A factual basis for land use and the management of the soils in Scott County, particularly as related to the development and use of the resources of the Tennessee River watershed, is provided by this cooperative soil survey. The data have been used in the preparation of a detailed soil map of the county and in the organization of information on the nature, extent, and productivity of each of the 100 soil types, phases, complexes, and miscellaneous land types recognized and mapped. The suitability of each soil for crops, pasture, or forest was determined and information obtained about the common practices of soil management and the resulting crop yields.

In all, 38 soil series are recognized. They are grouped according to position into (1) soils of uplands, (2) soils of colluvial lands, (3) soils of terraces, and (4) soils of bottom lands.
In this survey, land use and soil management are considered, and the soils are further grouped according to similarities of management requirements, each group with respect to choice and rotation of crops; use of commercial fertilizer, lime, and manure; tillage practices; and engineering methods for the control of water on the land. Practices for the improvement and management of pasture also are considered. Thus, the First-, Second-, and Third-class soils, all of which are considered at least fairly well suited to crops, are divided into 10 groups on the basis of management requirements for soils under tillage. The Fourth-class soils, which are considered well suited to pasture, are divided into eight groups according to requirements for pasture management. The Fifth-class soils, suited mainly to forest, are placed in a single group.

Productivity ratings for crops were obtained from expected yields estimated for each soil and for each crop commonly grown on the soil under each of three defined levels of management. Although the yields commonly obtained are much higher than can be expected under low levels of management, large increases are possible on most of the soils from improvement of management practices within feasible limits. Productivity ratings were also obtained for pasture.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Scott County is located in the extreme southwestern part of the State (fig. 1). The county adjoins Tennessee on the south and is separated from Kentucky on the northwest by Lee and Wise Counties. Gate City, the county seat, is 200 miles southwest of Richmond and 350 miles west of Norfolk. The roughly triangular outline of the

![Figure 1.—Location of Scott County in Virginia.](image)

boundaries is formed by a somewhat winding mountain ridge on the northwest and by straight lines on the south and east. The greatest distance across the county from east to west is about 38 miles and from north to south about 21 miles. The county comprises an area of 538 square miles, or 344,320 acres.
PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Scott County is situated almost wholly within the Appalachian Valley, a well-defined physiographic division of the Appalachian province extending from New York to Alabama and crossing the western part of Virginia. In Virginia this valley is known as the Great Valley of Virginia, and in Scott County it lies between the Cumberland Plateau on the northwest and the Appalachian Mountains on the southeast. A small area of the northern part of the county is in the Cumberland Plateau, and the southern edge is about 35 miles northwest of the foot of the Appalachian Mountains.

The county is in one of the narrowest parts of the Appalachian Valley, which varies from about 40 to 125 miles in width. This valley coincides with a belt of folded rocks, which are almost entirely sedimentary in origin and in a large measure calcareous. The rock layers, which doubtless were originally nearly horizontal, are tilted at various angles and intersect the surface in narrow belts. The surface configuration changes with the outcrops of the different kinds of rocks, and sharp ridges and narrow valleys of great length follow the narrow belts of hard and soft rocks. These ridges and valleys have a northeast-southwest trend, and the succession of parallel ridges that characterizes the surface features is in sharp contrast with the Cumberland Plateau country immediately to the north. There the almost completely dissected tableland is cut by streams that flow in narrow V-shaped ravines, and the divides rise 500 to 1,000 feet above the streams in narrow irregular lines of knobs showing very little resemblance to the original surface.2

In the remote past the region in which Scott County is located was doubtless an elevated plain. The evenness of the skyline of Clinch Mountain, Powell Mountain, and the Cumberland Plateau indicates the existence of such a plain, which formerly included the Appalachian Valley, the Cumberland Plateau, and the Blue Ridge Plateau. Erosion and the dissolution of limestone reduced this ancient plain to another that is represented approximately by the crests of the various intermountain ridges. The latest level to which erosion and solution have reduced the land surface is the bottom positions near streams.

Differences in the hardness of the underlying rocks and geologic structure, or the arrangement of the rocks, caused the unequal wearing down of the former land surfaces. Clinch Mountain, Powell Mountain, Stony Ridge, and the Cumberland Plateau are covered by resistant sandstone, which has preserved them from destruction by the forces of weathering. Much of the intermountain country is underlain by shale and limestone, which are softer and less resistant to weathering than sandstone. The purer limestone disappears through solution by water rather than through disintegration by weathering, and because of its softness it breaks down faster than either shale or sandstone. Some of the lowest valley uplands are underlain by the purer limestone, and the lowness of these uplands doubtless is due to the comparatively rapid deterioration of the limestone through solution. In the limestone belts much shale and sandstone is interstratified with the limestone; and much chert, a light-gray hard flinty

mineral, is present in the limestone near the outcrop. By their resistance to weathering, the shale, sandstone, and chert help support the limestone ridges in the intermountain country. Thus unequal weathering, caused by the hardness and the softness of the different rocks, has brought about much unevenness and variation in the surface of the land.

Over most of the county the relief is hilly, steep, or broken (pl. 1, A and B). Some of the smoothest uplands are on Copper Ridge, Moccasin Ridge, in Rye Cove, in the valley of the North Fork Clinch River near Pattonsville and Fairview, and in Poor Valley. Even these comparatively smooth uplands, however, contain areas of hilly and steep country. Limestone sinks, some of which are arable, have formed in places and range from a few feet to several hundred feet across. A few sinks contain water.

Stream terraces, first bottoms near streams, and narrow outwash areas near the base of slopes generally have the smoothest relief. Such relief is found near the North Fork Holston River, in Poor Valley near Maces Spring and Hilton, near Big Moccasin Creek and Copper Creek, along the Clinch River near Dungannon and Fort Blackmore, along Stony Creek north of Fort Blackmore, and along the North Fork Clinch River near Duffield.

Elevations range from about 1,200 feet, at the points where the North Fork Holston River and the Clinch River cross the Virginia-Tennessee boundary line, to about 4,000 feet, at Camp Rock in the northern part of the county. The elevations of first bottoms near streams range from 1,200 to 1,500 feet and of valley uplands from 1,500 to 2,400 feet. The general slope of the county is southwestward.

The elevations of several places are as follows: In the northern part, Flatwoods, 2,200 feet; Dungannon, about 1,400; and Fort Blackmore, 1,280; in the eastern part, Nickelsville, about 2,000 feet; and Snowflake, about 1,600; in the southern part, Maces Spring and Gate City about 1,400 feet each; and Hilton, about 1,300; and in the western part, Pattonsville, 1,710 feet; Duffield, 1,412; Speers Ferry, 1,390; Clinchport, 1,286; and Fairview, about 1,200.

The Cumberland Plateau, extending about 8 miles into the northern part of the county, ranges in elevation from 2,000 to 3,000 feet. Powell Mountain is in the northwestern part, and its crest forms the county line for about 28 miles. Its elevation reaches 4,000 feet at Camp Rock, the highest point in the county. The mountainsides are steep and in places broken. Some fairly wide areas of smooth country are found on the top of the mountain and on the tops of some short spurs.

Stone Mountain, in the northern part, near the foot of Powell Mountain, is 11 miles long and ½ mile wide and has an elevation of 2,700 feet. Chestnut Ridge, about 8 miles long and about 2,000 feet high, lies immediately south of and parallel to Stone Mountain. Copper Ridge begins in the central part, at the junction of the Clinch River and Copper Creek, and extends northeastward into Russell County. In Scott County this ridge has an extent of about 24 miles and a range in elevation from 2,000 to 2,500 feet. The ridge has a comparatively wide and fairly smooth top and several smooth-topped spurs.

\*1Data from United States Geological Survey topographic maps.
Rye Cove lies northeast of Clinchport and is an unusual feature in the uplands, since it comprises about 25 square miles of markedly smooth relief. It is about 6 miles long and 4 miles wide. Its elevation, ranging from 1,500 feet to 1,900 feet, is somewhat lower than that of nearby Copper Ridge.

Moccasin Ridge crosses the southeastern part of the county just north of Clinch Mountain and has the same trend as that mountain. It is about 23 miles long and reaches an elevation of 2,300 feet at the Russell County line. Clinch Mountain extends for about 30 miles across the southeastern part of the county. It has a winding contour and a narrow crest with many rock escarpments. Big Knob, its highest point, has an elevation of about 3,150 feet. Pine Mountain, a narrow ridge lying just south of Clinch Mountain, has an elevation of 1,700 feet.

Stony Ridge, Newman Ridge, and The Big Ridge are in the western part of the county, Stony Ridge and Newman Ridge extending southward into Lee County, and The Big Ridge southwestward into Tennessee. Purchase Ridge is in the western part of the county just south of Duffield. The parts of the ridges within the county range from 3 to 9 miles in length and from 2,000 to 2,400 feet in elevation. Their tops are narrow, and their slopes steep.

In the southeastern part, south of the North Fork Holston River, an area of about 30 square miles has hilly and knobby relief and at an elevation of about 2,000 feet is dissected by many small drainageways.

Outlets for the drainage of the county are the Clinch River, the North Fork Clinch River, and the North Fork Holston River. These streams have cut channels to a depth of 300 to 500 feet below the general level of the valley uplands, and to a depth of 1,200 to 1,500 feet below the general level of Clinch and Powell Mountains.

The Clinch River flows diagonally across the county from the northeastern corner and crosses the Tennessee boundary line near the southwestern corner. Its main tributaries, entering from the northwest, are Stock Creek, Cove Creek, and Stony Creek; and from the east, Copper Creek, which flows from Russell County. The drainage basin of the Clinch River comprises about 400 square miles in the county.

The North Fork Clinch River crosses the extreme western part of the county and flows into Tennessee at the southwestern corner. Its drainage basin comprises an area of about 50 square miles in the county.

Big Moccasin and Opossum Creeks are the main tributaries in the county of the North Fork Holston River. Big Moccasin Creek enters from the east out of Russell County. It passes through Clinch Mountain at Big Moccasin Gap, which is a water-level gap and by its easy access is a natural gateway between the North Fork Holston and the Clinch River Valleys. Opossum Creek enters from Tennessee and flows eastward near the Tennessee boundary line before emptying into the North Fork Holston River. The drainage basin of the North Fork Holston River covers about 90 square miles in the county.

Many small creeks, branches, and intermittent drainageways extend from the main streams into all sections, and one or more of them serve as drainage outlets for every farm. The rolling, hilly, and steep relief of the uplands is well to excessively drained. The only poorly drained
areas are the low flat places on stream terraces and in first bottoms near streams and in a few limestone sinks.

Some of the streams do not enter the main drainageways but disappear in underground passageways, many possibly to emerge later as springs.

CLIMATE

The climate of Scott County is continental, as the county is far enough inland to be out of reach of any modifying effects of the ocean. Considerable difference exists between the mean temperatures of summer and winter. The winters are short and cold, with occasional warm spells; the summers warm, with occasional very warm days. Summer evenings and nights are usually cool and pleasant. The climate is healthful and is favorable to the type of agriculture pursued. Outdoor work can be performed in winter, except on unusually cold days. Wheat, barley, rye, oats, and cover crops are grown successfully, and hardy vegetables, as parsnips, turnips, and kale, can be grown.

The average frost-free season is 182 days, extending from April 19 to October 18, which is sufficient for maturing the crops commonly grown. The latest killing frost on record in spring was on May 11, and the earliest in fall on October 2. The grazing period extends from April 1 to November 1, although its length is determined largely by character of soil, moisture conditions, and pasture management.

Some truck crops can be grown in low areas, particularly in the North Fork Holston and the Poor Valleys, but very little truck cropping is done, because selling is difficult in competition with truck growers farther south.

The rainfall is ample for the crops commonly grown and is well distributed. The greatest mean rainfall comes in summer, and the smallest in fall, affording a favorable harvesting season. Light or moderate showers and heavy thunderstorms occur in summer, as well as occasional steady rains, which continue for 3 or 4 days, soak well into the ground, and result in much washing of the soil in places. Hard showers and protracted rains come also in other seasons. Hailstorms are sometimes destructive late in spring and in summer. Widespread droughts rarely occur, but local droughts sometimes injure crops. The snowfall generally is light and remains on the ground only a brief time. Snow has fallen as early as October and as late as April.

The more important climatic data for the county, compiled from the records of the United States Weather Bureau stations at Clinchport, in Scott County, and at Pennington Gap, in Lee County, are given in table 1. The temperature data are from records at Pennington Gap, as no temperature records for Scott County are available.

WATER SUPPLY

The many streams of the county normally afford ample water for cattle, but there is a shortage in many of the smaller streams during protracted dry weather. Water collects in some limestone sinks and becomes available to cattle. The many springs in the county constitute the main source of water for domestic use. In some places, particularly on Copper Ridge and in Rye Cove, it is necessary to supplement the supply with water from cisterns or wells.
Table 1.—Normal monthly, seasonal, and annual precipitation and temperature at Clinchport, Scott County, Va., and Pennington Gap, Lee County, Va., respectively

[Elevation, Clinchport, 1,300 feet; Pennington Gap, 1,386 feet]

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<th>Month</th>
<th>Temperature (Pennington Gap)</th>
<th>Precipitation (Clinchport)</th>
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<td>Absolute maximum °F.</td>
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<td>December</td>
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<td>January</td>
<td>36.7</td>
<td>72</td>
</tr>
<tr>
<td>February</td>
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</tr>
<tr>
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<td></td>
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<tr>
<td>March</td>
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<td>81</td>
</tr>
<tr>
<td>April</td>
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<td>93</td>
</tr>
<tr>
<td>May</td>
<td>63.7</td>
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<tr>
<td>Spring</td>
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</tr>
<tr>
<td>June</td>
<td>70.8</td>
<td>100</td>
</tr>
<tr>
<td>July</td>
<td>74.2</td>
<td>97</td>
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<tr>
<td>August</td>
<td>73.7</td>
<td>100</td>
</tr>
<tr>
<td>Summer</td>
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<td>100</td>
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<tr>
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<td>99</td>
</tr>
<tr>
<td>October</td>
<td>56.8</td>
<td>93</td>
</tr>
<tr>
<td>November</td>
<td>44.4</td>
<td>82</td>
</tr>
<tr>
<td>Fall</td>
<td>56.6</td>
<td>99</td>
</tr>
<tr>
<td>Year</td>
<td>55.2</td>
<td>100</td>
</tr>
</tbody>
</table>

1 Trace. 2 In 1925. 3 In 1906.

The Clinch River and the North Fork Holston River furnish many good places in which to fish and to swim. Almost all the mountain streams are stocked each year with trout. Stony, Staunton, and Cove Creeks are favorite fishing streams. Several large ponds in limestone sinks are stocked with carp.

**VEGETATION**

The principal trees in the county in 1830 were tuliptree (yellow-poplar), hickory, beech, sugar maple, white and black oaks, linden, buckeye, and black walnut. Chestnut grew on the mountains and ridges, and wild cherry in many places. Possibly 50 percent of the county is now covered by forests, nearly all of which consist of second-growth trees of various sizes.

*Addington, R. M. History of Scott County, Virginia.* 364 pp., illus. Kingsport, Tenn. 1932.
Southwestern Virginia was heavily timbered until the forest was removed from the valley uplands to make room for settlements. Then began the cutting of prime walnut, tuliptree, and oak, the only trees that could be economically removed while transportation facilities were undeveloped. With the advent of railroads and better highways, more and more of less desirable and less accessible timber could be logged. The opening of the Virginia coal fields made possible the utilization of great quantities of small timber and inferior species.

Four forest types—cove, slope, ridge, and hemlock-bottom—are in Scott County, but fires and cutting have somewhat altered their composition. The cove type, occupying between 10 and 15 percent of the forest area, is composed of tuliptree, cumbertree, linden, white and Northern red oaks, white ash, buckeye, hickory, hard maple, beech, black tupelo (blackgum), and black walnut. This type is restricted to deep fertile soils in coves and on river benches. The trees respond well to the excellent growing conditions afforded by soil fertility, soil moisture, and high humidity. The trees are thrifty, straight, and fast growing and have maximum commercial length free from branches. Although tuliptree has been continuously removed over a long period of years for saw timber and pulpwood, its power of reproduction and rate of growth are as great as ever.

The slope type covers the lower and middle mountain slopes where the soil is fairly well supplied with moisture and has moderate depth. About 50 percent of the forest of the county consists of this type. White oak predominates and is the most valuable species. Northern red, black, and chestnut oaks, scrub pine, and chestnut are in the white oak stand on the upper slopes but lower down become less abundant, and tuliptree, persimmon, linden, beech, buckeye, and others more characteristic of the coves become more numerous.

The ridge type occupies the upper slopes, where the exposures are more severe and the soil thinner. Chestnut oak and chestnut are the most numerous, and associated with them are black and red oaks and pitch pine. The trees of this type are crooked and limby, and the stand is very open. Eventually these forests will be managed so as to protect the watersheds and to furnish a continuous supply of extract wood, mine timbers, cordwood, and tanbark.

The hemlock-bottom type, which includes about 5 percent of the forest, is confined to areas near streams and will not be of major commercial importance. Hemlock is the predominant species and appears in many places in pure stands. Other species in this type are sycamore, soft maple, elm, beech, and river birch.²

On the valley uplands most of the deep well-drained soil underlain by limestone is cleared and cultivated, but a few black walnut, black locust, and white and other oaks remain here and there. The most common trees growing on shallow soil in the limestone areas are red cedar (pl. 1, C), black walnut, black locust, and scarlet and red oaks. On the chestnut ridges, or cherty ridges, in the valleys chestnut formerly predominated; but the European blight has killed most of the chestnuts, and the main trees now are scarlet and red oaks, tuliptree, buckeye, beech, and dogwood. Sycamore, black and yellow willows, and alder grow in many places in the valley near streams.

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²Virginia Polytechnic Institute, Engineering Extension Division, Industrial Survey. Scott County, Virginia. 69 pp., illus. Blacksburg, Va. 1929.
HISTORY AND POPULATION

The territory now occupied by Scott County was hunted over and fought for by many tribes of Indians. According to evidence found by the early settlers an Indian village once stood on the south bank of the Clinch River near the mouth of Stony Creek.

Next to the rich virgin soil, wild game was perhaps the greatest inducement to the pioneer hunters to enter a wilderness often made dangerous by the presence of hostile Indians. Some of these men came as Long Hunters and fur traders, explored the country, and marked traces to be followed by adventurous home seekers and their families. These early explorations and settlements would hardly have been possible without the food that the wild game provided.

Forts were built for protection against Indians. The Blockhouse, built sometime before 1782 and situated about 4 miles southeast of Big Moccasin Gap at the meeting point of the pioneer roads from Virginia and North Carolina, was one of the most widely known places on the Wilderness Road. It was possibly the only blockhouse in the county, the other forts being log cabins and stockades.

Fort Blackmore, early a famous fort, was situated on an ancient elevated flood plain on the north side of the Clinch River opposite the mouth of Rocky Branch. For many years this fort was on the extreme frontier of Virginia and was used by hunters, explorers, adventurers, and home seekers for rest and refreshment. Daniel Boone was in command of Fort Blackmore and other forts on the Clinch River in 1774 while the militiamen were engaged in the Point Pleasant campaign of Dunmore's war.

Many other forts were built in the early days. In Rye Cove, Crims' Fort was built in 1776 and Carters Fort in 1784. Porter's Fort was built on Fall Creek in 1775. Fort Houston was built probably soon after 1774 on Big Moccasin Creek near the present Russell County line and was a place of safety for the earliest settlers in that valley. Dortons Fort, built 1 mile southwest of Nickelsville about 1790, was not so exposed to Indian attacks as the forts built earlier.

Big Moccasin Gap, a breach in the hard rocks of Clinch Mountain, is perhaps the most important natural feature in the county, for in it centered much of the early history and development. Through the gap Daniel Boone and his companions carved the Wilderness Road to Kentucky in 1775 and through it thousands of pioneer settlers passed on their way to Kentucky and the Middle West. Most of the goods used by the people who lived north of the Clinch River were hauled through the gap before the coming of the railroad. The first railroad in the county was built through Big Moccasin Gap, and most of the main highways now lead toward it.

Thomas McCulloch, the first settler, located in 1769 on Big Moccasin Creek, near Fort Houston. From 1769 to 1782 many people came to live in what is now Scott County, and settlements increased until they reached nearly all sections. In 1799 strongly built houses began to take the place of forts; and one of these, the Old Kilgore Fort House, about 2 miles west of Nickelsville, is still standing. It is probably the oldest house in the county. Convenience to water was one of the main considerations in the selection of home sites, and most of the early homes were located on lowland.
The early settlers were mainly Scotch-Irish, though some were of English descent. They came from eastern Virginia, from Augusta County, Va., from the Yadkin Valley, N. C., and a few from Ireland. Some of the thousands who traveled the old Wilderness Road on their way westward grew weary of traveling, turned aside, and settled in the Scott County territory. A string of log cabins soon lined the Wilderness Road from the Blockhouse to Cain Gap, in Powell Mountain.

Scott County was formed by an act of the general assembly on November 24, 1814, from parts of Washington, Lee, and Russell Counties and was named for Gen. Winfield Scott. Its area in 1830 was 624 square miles. In 1856 part of Scott County was taken to form part of Wise County. The first court was held in a dwelling at Big Moccasin Gap in 1815, and the first public free schools were opened in 1870.

The population still consists largely of descendants of the early settlers. In 1940 the population was 26,989. The Negro population was 309. The density of population is 50.1 persons a square mile. Most of the people live on smooth land near streams and on the smoother ridge tops in the valley uplands. Very few live in the steep and rugged mountain country. Much of the land is unsuitable for intensive use. The county now has all the population, or possibly more, than it can well support.

Gate City, on the Southern Railway, is the largest town (population 1,565) and contains most of the industries of the county, which include flour and planing mills and print shops. A large limestone quarry is located immediately west of Gate City. Fort Blackmore (population 500) is on the Clinchfield Railroad in the northern part of the county, and is a local trading center. Clinchport (population 346), in the western part and on the Southern Railway, is a trading place and shipping point for the immediate agricultural region. Dungannon (population 333), in the northeastern part, is a local trading place and a shipping point on the Clinchfield Railroad. The county fair is held there. Nickelsville (population 256) is a trading and meeting place for farmers living in the eastern part of the county and is not served by a railroad. Hilton (population 250) is a local trading place on the Southern Railway in the southeastern part.

INDUSTRIES

Probably not more than 100 industrial workers, including those in grist and corn mills, are employed in Scott County. Some of the people are in business, but most of them are farmers or are engaged in work connected with farming.

An area of about 59 square miles of coal-bearing strata is in the northern part of the county. The rock beds at the surface belong chiefly to the lower part of the Pennsylvanian series, known as the Lee formation, and contain locally a little of the base of the underlying Norton formation. The higher beds that contain most of the coal in Wise County are not present in Scott County. The Lee formation in Scott County is about 1,500 feet thick and is composed of sandstone and shale. The coal seams lie chiefly in the shale. Many coal seams appear in the rocks, and most of them are thin, lenticular, and poorly correlated, but locally are of minable thickness. Very little coal has
A. Landscape almost entirely of Tea-Litz soils, which are largely in forest, though occasionally parts are in pasture.

B. Muskingum soil on steep ridge slopes in background, Carbo stony silty clay loam on lower less steep hilly land in foreground.

C. Vegetative cover marking a definite boundary between two soil areas: In the background Tea-Litz soils have a cover mainly of oak, in the foreground Rough stony land (limestone material) has a redcedar cover.
Representative farm dwellings:

A. On cherty ridges in areas where the soils are capable of sustaining a fairly
good type of agriculture.

B. One of the earlier types still standing in a less productive part of the county,
as a mountamous area or shaly valley.
been mined for shipment, though some has been mined at various places for local use.

Several coal seams have been worked to a limited extent along some of the streams. In Stock, Stony, McGhee, Dry, and Little Stony Creeks basins prospects and mines indicate that coal seams range in thickness from 12 to 96 inches. Many of these seams are distant from the railroads and are not easily accessible for shipping coal. Near the railroads the strata have been disturbed, and the usual mining difficulties incident to such areas are encountered. Future operations will be in the undisturbed part of the coal area, where thickness and quality are expected to be somewhat uniform.

Shale, argillaceous limestone, and pure limestone found in places are of such quality as to offer satisfactory ingredients for portland cement. Limestone for use in a portland cement plant at Kingsport, Tenn., has been quarried at Marcem in Scott County.

Although six or eight natural gas wells have been drilled in the southeastern part, only one is operated, and the gas from it is piped to Bristol, Va.-Tenn.

Some lumbering is done in the county. An average of about 4,000 board feet an acre is obtained from the timber logged. Products of the forest are mainly pulpwwood, export stock, veneer logs, tanbark, mine props, lumber, and fuel wood.

TRANSPORTATION AND MARKETS

Adequate railroad facilities for the county are supplied by the Southern Railway and the Clinchfield Railroad. The Southern Railway enters the western part of the county near Duffield, passes through Speers Ferry, Gate City, and Hilton, and enters Washington County on its route to Bristol, Va.-Tenn., where it connects with the Radford-Bristol branch of the Norfolk & Western Railway. The Clinchfield Railroad enters the northeastern part near Miller Yard and extends near the Clinch River southwestward to Speers Ferry, where it turns southeastward into Tennessee. These two railroads thus pass through the principal towns in the county and through or near all the agricultural parts.

Every agricultural community in the county has access to one or more public roads. United States Highway No. 58, a hard-surfaced highway, crosses the southern part in an east-west direction and passes through Big Moccasin Gap, Gate City, Speers Ferry, and Patonsville. Hard-surfaced roads connect this highway with Big Stone Gap, in Wise County, and with Kingsport, Tenn. Practically all the other public roads are of gravel or dirt. Most of the public roads are kept in good condition throughout the year. Some thickly populated areas, however, have only fair, or poor, public roads. In 1940, according to farms reporting, 481 were on hard-surfaced roads; 701 on gravel, shell, or shale roads; 1,541 on improved dirt roads; and 1,014 on unimproved dirt roads.

Many beef cattle are bought in Texas as calves, and when about 2 years old are sold to cattle buyers in Russell and Tazewell Counties. Some of the native calves are disposed of as veal and some are kept until they are a year or two old and sold as feeders to beef-cattle farmers in this and neighboring counties. The heavy cattle are shipped to markets in Jersey City and Philadelphia. Lambs and
sheep are sold mostly in Jersey City. Tobacco is marketed at Abingdon, Va.; Johnson City, Tenn., and other nearby places. Some whole milk and cream are sold in Bristol, Va.-Tenn., and in Kingsport, Tenn.

CULTURAL DEVELOPMENT AND IMPROVEMENT

Schools and churches are located at convenient places in all parts of the county. Prior to the opening of the public free schools rather primitive types of the old field schools were the only ones in the county. These were taught either in meeting houses or dwellings, and the school terms were of 3½ to 5 months. The teacher was a farmer, preacher, or one who was physically unable to make a living except by teaching, the preparation for which usually consisted of what was acquired at the local schools. Some teachers probably supplemented their preparation with a few months' study at an academy or a seminary. Later better schoolhouses were built and better equipment used. The county made such good progress that it received a prize at the Jamestown Exposition for improvements in school buildings. In recent years unusual progress has been made in improving the school buildings and the standards of instruction. Modern buildings, constructed of cement or brick, are taking the place of one- and two-room school buildings. The school system includes 7 senior high schools, 4 junior high schools, 58 elementary schools, and 1 school for colored pupils.

Telephone lines extend into some parts of the county. In 1940 a total of 32 farms reported having telephones: 1,217 that an electric distribution line was within one-fourth of a mile of the farm dwelling; and 520 that the dwelling was lighted by electricity. The electricity for lighting was obtained from a home plant on nine farms.

The farm homes vary in size from one to six rooms or more (pl. 2). The tenant homes—many of which are poorly kept and poorly painted—have two to four rooms.

Home improvements and the kind and condition of farm buildings and farm machinery depend largely on the slope of the land and the character of the soil. In the mountainous and steep ridge parts, where so much marginal and submarginal land exists, many buildings of the pioneer type are in use and old methods of farming are common. In parts where the slope of the land is favorable, the land easy to till, and the soil productive there are many modern and reconditioned buildings and improved farm machinery.

On the better farms the barns are large enough to shelter work animals and store farm machinery. On many farms, in addition to the barn, there are outbuildings for storage purposes. In the smoother parts of the county the better farms are enclosed with good wire fences, but in the steeper parts some are fenced with wood rails and others with poorly kept fences of one or two strands of barbed wire. Rock fences made of field stones are in use on some farms.

AGRICULTURE

Because of the danger of Indian attacks early farming was done under great handicap. The settlers along the Clinch River lived on their farms in winter and made improvements, but with the approach
of warm weather, when Indians could go on the warpath, they took
to the forts for safety. Fort Blackmore was so exposed to Indian
attack that often the few settlers living within it dared not venture
out to cultivate crops in the clearings unless accompanied by a strong
guard; and if no guard was available they were compelled to spend
much time within the fort. In such circumstances the settlers were
often reduced to narrow straits for food; and during threatened
famine most of their food had to be transported through Big Moccasin
Gap on pack horses under military escort from older and less exposed
settlements on the Holston River.

From the days of the early settlers until now agriculture has been
the chief occupation of the people of Scott County, though lumbering
has been important at times. Early agriculture consisted in growing
corn, wheat, rye, barley, buckwheat, flax, sorghum cane, tobacco,
potatoes, garden vegetables, apples, and peaches and in raising horses,
cattle, sheep, and hogs. The production of maple sugar was rather
extensive. Tobacco was a medium of exchange and could be used to
pay court witnesses and court officers. The early settlers hunted and
trapped, and some used furs and pelts to purchase supplies.

The early agriculture was characteristic of a pioneer community.
Nearly every farmer grew flax in order to have a supply of linen for
towels, sheets, ticking, shirts, pants, thread, and ropes. Sheep were
kept on many farms, and their wool was used for making cloth. Hand
looms were used for weaving, and the products of the looms included
jeans, linsey, flannel, blankets, tow linen, counterpanes, coverlets, and
rag carpet. Coloring material for cloth was obtained mostly from
bark, roots, and berries. Red coloring material was furnished by sumac berries and madder; black by oak bark and logwood; and dove
by cedar berries.

Products from sorghum cane and sugar maples were important to
the pioneers. Molasses was made on nearly every farm from plantings
of sorghum cane. Before the large forests of sugar maple trees were
cut down and the land upon which they grew was used for grain and
meadow, the making of maple sugar, principally in the homes, was
extensive. In 1840 the output of maple sugar in the county was
60,000 pounds.

Ginseng and other herbs of real or supposed medicinal value grew
abundantly on the north hillsides. Ginseng, however, had the greatest
commercial value, and was sought for in the dense forests.

Fruit and berries were dried for winter use and for sale. As glass
fruit jars were not introduced until about 1880, drying was the only
means of preserving. Some owners of large orchards built drying
houses and dried their fruit on a large scale. Considerable trade
existed in dried fruit and berries, but the prices were low.

In the early agriculture grain was trod out of the sheaf by horses
and cattle in a large shed built for the purpose. Barns with grain-
tight threshing floors came into use later, and the grain was beaten out
of the head with a flail. Grain was winnowed by means of a cloth
sheet. Fan mills for separating wheat from chaff were introduced in
the county between 1880 and 1840. Grain was reduced to meal or
flour by various devices; one of the simplest was that of beating it
in a mortar with a pestle. The early grain mills were run by water-
power.
Ranges and forests provided much of the feed for cattle and hogs. Wild peavine and the grasses of the ranges were so good that a relatively large number of cattle were kept. An ample supply of milk was produced for domestic use, and some surplus was produced. Milk cows were fed on shucks and other rough feed. Hogs were fattened on sweet mast, consisting of white oak acorns, chestnuts, and beechnuts, and were put in pens about 2 weeks before slaughter and fed on corn. Many hogs ran wild.

Prior to the days of the railroad the transportation of heavy or bulky material was difficult. The nearest early markets were Lynchburg and Richmond; later, Abingdon and Bristol. To overcome the difficulty of distant transportation, small local manufacturing plants were established. Iron furnaces were built in many sections, and the output supplied enough iron for the people to make farm implements and other articles.

Farming implements were handmade. Colters, single- and double-shovel plows, harrow teeth, weeding hoes, sprouting hoes, ginseng hoes, and mattocks were produced in blacksmith shops, but the wooden parts for these implements were fashioned by the farmer himself. Sickles, scythes, and cradles were used in harvesting.

Wooden rails were used to fence fields and clearings, the rails being made from trees that grew on the land cleared. Gardens and yards were enclosed with sharp-pointed palings.

As wagons were not suited to steep land where no roads had been built, most of the pioneers did their hauling on sleds. Corn, potatoes, and other products were hauled to markets on sleds with standards attached.

By 1830 the population was 5,734. The leading crops were Indian corn, wheat, rye, oats, hemp, and flax. Apples and peaches were grown in abundance. Many horses, horned cattle, and hogs were raised and driven to markets outside the county. The Clinch River and the North Fork Holston River were sources of fine fish. Several tanyards and a relatively large number of flour mills were operating. Sawmills were attached to many of the flour mills, and carding mills to a few.

Rough relief made road building a difficult task. In its very early sessions the county court applied itself to matters concerning the construction of a system of roads, and a large percentage of the court orders from 1815 to 1870 pertained to roads and ferries.

Before the construction of a railroad in the county, the North Fork Holston River and the Clinch River afforded means of transportation to Chattanooga, Tenn. These rivers were navigated by various kinds of craft, ranging from canoes to flat-bottom boats. Boat cargoes on the Clinch River consisted of wheat, corn, and bacon, and on the North Fork Holston River, in addition to these commodities, salt from the salt works on that river. Boats of the larger class would transport cargoes of corn and wheat ranging from 1,000 to 1,800 bushels; and 10 to 15 boats carried an aggregate of 15,000 to 20,000 bushels of grain every year down the Clinch River for delivery at Chattanooga. Although river traffic in grain ceased with the coming of the railroad, boatmen continued in river transportation by rafting logs to Chattanooga and to other points on the Tennessee River. In some years more than 100 double rafts containing 50,000 to 75,000 feet of lumber would be floated from Scott County.
The first passenger train reached Gate City on July 4, 1887. Its coming was significant, for it released the county from mountain barriers and brought the people in direct communication with the outside world. With the entry of the railroad the hand cards, carding machines, spinning wheels, and hand looms passed out of use; and the threshing flails, simple threshing machines, schooner wagons, and other crude implements of agriculture soon gave place to modern equipment. Furthermore, the entry of the railroad ushered in a new era of schoolhouse building.

The agriculture at the present time consists mainly of producing grain, hay crops, and livestock. Tobacco is grown on a comparatively large total acreage. Corn and wheat are the principal grain crops, and barley and rye are minor grain crops. Oats, which are largely cut green and fed unthreshed, are grown to some extent.

Potatoes, sweetpotatoes, and garden vegetables are produced on many farms; apples and pears on a fairly large number; and cherries, peaches, plums, and grapes on a fewer number. Several large orchards produce apples mainly for local use. Sorghum cane for sirup is grown on a relatively small number of farms. Forest products are important on a few.

The value of all agricultural products and domestic animals in the county in stated years, compiled from Federal census reports, is shown in table 2.

**Table 2.—Value of all agricultural products and domestic animals by classes in Scott County, Va., in stated years**

<table>
<thead>
<tr>
<th>Product</th>
<th>1909</th>
<th>1919</th>
<th>1929</th>
<th>1939</th>
</tr>
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<tbody>
<tr>
<td>Cereals</td>
<td>$583,464</td>
<td>$1,666,874</td>
<td>$700,147</td>
<td>$583,912</td>
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<tr>
<td>Other grains and seeds</td>
<td>1,392</td>
<td>4,346</td>
<td>1,052</td>
<td>771</td>
</tr>
<tr>
<td>Hay and forage</td>
<td>160,122</td>
<td>606,707</td>
<td>250,651</td>
<td>243,050</td>
</tr>
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<td>All vegetables</td>
<td>138,792</td>
<td>328,886</td>
<td>380,901</td>
<td>337,719</td>
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<td>Vegetables for sale (except potatoes and sweetpotatoes)</td>
<td>12,148</td>
<td>5,599</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetables for home use (except potatoes and sweetpotatoes)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruits and nuts</td>
<td>63,946</td>
<td>147,751</td>
<td>114,357</td>
<td>42,604</td>
</tr>
<tr>
<td>All other field crops</td>
<td>138,063</td>
<td>82,520</td>
<td>170,478</td>
<td>558,414</td>
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<td>Forest products, cut on farms for home use and for sale</td>
<td>242,033</td>
<td></td>
<td>18,888</td>
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<tr>
<td>Domestic animals</td>
<td>1,179,576</td>
<td>1,638,681</td>
<td>1,366,202</td>
<td>1,175,301</td>
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<tr>
<td>Animals sold and slaughtered</td>
<td>650,608</td>
<td></td>
<td></td>
<td>409,566</td>
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<td>Dairy products sold</td>
<td>19,151</td>
<td>246,423</td>
<td>75,173</td>
<td>36,714</td>
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<tr>
<td>Poultry and eggs</td>
<td>215,424</td>
<td>446,371</td>
<td>605,732</td>
<td>240,211</td>
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<tr>
<td>Honey</td>
<td>3,655</td>
<td>8,970</td>
<td>5,118</td>
<td>2,191</td>
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<tr>
<td>Wool</td>
<td>8,209</td>
<td>10,006</td>
<td>8,942</td>
<td>4,294</td>
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</table>

1 Forest products sold.
2 In 1940.
3 Includes wax value.
CROPS

In 1879 the leading crops were corn, wheat, oats, and hay, and the minor crops rye and buckwheat. Special crops included sweetpotatoes and tobacco, each of which occupied a rather small total acreage. Sorghum cane and maple were the sugar crops grown; and 40,656 gallons of sorghum sirup, 8,334 pounds of maple sugar, and 534 gallons of maple sirup were produced.

Since 1879 significant changes have taken place in the relative importance and acreage of the crops. Corn, the leading crop, showed a large decrease in acreage, and oats almost disappeared as a grain crop. Wheat, rye, and buckwheat also showed large decreases in acreage, but wheat had a greater acreage in 1939 than in 1929. Barley came into prominence in 1899. Hay increased in acreage, and lespedeza became prominent as a hay crop in 1899. Potatoes showed a large acreage increase, and sweetpotatoes a decrease. Tobacco (burley) came into prominence in 1929, and in 1939 its large acreage made it one of the important crops. Sorghum cane reached its greatest acreage in 1919, but by 1939 the acreage had been greatly reduced. The production of maple sugar and maple sirup apparently ceased before 1900, as the last records of production were for 1899. Although the number of fruit trees has fluctuated considerably, the tendency seems to be toward fewer apple and peach trees and more pear and cherry trees.

In 1939 corn was grown for grain on 3,554 farms reporting, and averaged 27.1 bushels an acre (pl. 3, A). The greatest acreage recorded was harvested in 1899, and the smallest in 1899. Most of the corn produced is used as subsistence for livestock, although some is ground into meal for use in bread.

Wheat was grown on 1,194 farms in 1939, with an average yield of 12 bushels an acre. Most of the wheat produced is ground into flour for domestic use, but some is sold locally for cash. The largest acreage reported planted in wheat was in 1879, and the smallest in 1929.

Oats for grain were reported grown on 136 farms in 1939, and averaged 14.1 bushels an acre. Oats cut green and fed unthreshed were reported grown on 408 farms. The largest acreage reported planted to oats for grain was in 1889 and the smallest in 1939. Barley was reported grown on 184 farms in 1939, with an average yield of 21.7 bushels. The largest acreage reported planted to this crop was in 1939, and the smallest in 1899. Rye was reported by 39 farms in 1939, with an average yield of 0.5 bushels.

In 1939 hay, exclusive of sorghums, was grown on 2,086 farms reporting, with an average yield of 1 ton an acre. The hay crops were chiefly timothy, clover, timothy and clover mixed, and lespedeza. The hay produced is fed mostly to work animals and dairy cattle on the farms.

Potatoes and sweetpotatoes and yams are grown mainly for home use. Reports from 2,638 farms in 1939 showed an average yield of 65.3 bushels of potatoes an acre; and from 762 farms an average yield of 59.8 bushels of sweetpotatoes and yams.

Vegetables for home consumption, excluding potatoes and sweetpotatoes, were grown by 3,621 farms in 1939. Vegetables harvested for sale, excluding potatoes and sweetpotatoes, were grown in 1939 on 105 farms reporting. According to the county agricultural agent, the
vegetable production in the county is not sufficient for local needs; and many vegetables that could be grown are bought at points outside.

Sorghum cane for sirup was grown in 1939, chiefly for home needs, on 337 farms reporting, with an average yield of 69.5 gallons an acre.

Tobacco (burley) was grown in 1939 as a cash crop on 2,853 farms. The acreage was the largest on record for the county and the average yield was 1,088.5 pounds an acre. Tobacco plant beds are prepared by burning brush, logs, and other wood on the ground to destroy weed seeds and insects. The tobacco seed is sown in properly prepared soil, and the plants are protected by a cloth cover until large enough to be transplanted in the field (pl. 3, B).

In 1939 apples were harvested on 1,848 farms, and averaged 1 bushel a tree; pears, on 1,071 farms, averaged 0.9 bushel a tree; cherries, on 846 farms, 5.0 pounds a tree; peaches, on 808 farms, 0.5 bushel a tree; and plums and prunes, on 261 farms, 0.7 bushel a tree. Grapes were grown on 589 farms, and the harvest from 1,639 vines on 316 farms averaged 19.2 pounds a vine. Tree fruits and grapes are produced mainly for domestic consumption.

The acreage of the principal crops and the number of fruit trees and grapevines in the county in stated years are shown in table 3.

**ROTATIONS AND FERTILIZERS**

Long and short crop rotations are practiced, depending on character of soil and lay of land. Some of the common rotations range from 4 to 6 years or more, and include corn, 1 year; small grain, 1 year; and hay crops, 2 to 4 years or more. The hay crops consist either of lespedeza or of timothy and clover mixed. In the 6-year rotation or in longer rotations the hay crops are pastured after the third year, but are seldom fertilized. A 3-year rotation also is common and includes corn or tobacco, 1 year; small grain, 1 year; and a hay crop of lespedeza or of timothy and clover mixed, 1 year. A 2-year rotation is practiced on a small acreage, consisting of corn or tobacco, 1 year, and small grain, 1 year, with lespedeza seeded in the small grain in the spring. Double cropping, consisting of corn and lespedeza, 1 year, is used to some extent. Some farmers allow the land to rest for 3 or 4 years after the corn is harvested before again planting it to corn.

In 1940, 2,382 farms, or 61.4 percent of the farms of the county, reported the purchase of 2,431 tons of commercial fertilizer in 1939 at a cost of $62,255, or $26.13 a farm. Fertilizer was purchased by 51.1 percent of the farms in 1919, and by 24.1 percent in 1909. In 1879 the amount spent for fertilizer was only $689. Most of the fertilizer used is purchased either from dealers by individual farmers or in carlots by groups of farmers. In 1940, 76 farms (2 percent) reported the purchase of 1,005 tons of liming materials.

About 60 percent of the farms use fertilizer for the production of corn, 60 to 80 percent for small-grain crops, and a large proportion for tobacco. Where fertilizer is not used for crops, manure is applied to the land. On some farms manure is applied with the fertilizer, especially in the production of tobacco. Many farmers have been well informed as to the fertilizers to use and are using more fertilizer of recommended formulas. For a long time 16-percent superphosphate was almost the only kind of fertilizer applied to
Table 3.—Acreage of the principal crops and the number of fruit trees and grapevines in Scott County, Va., in stated years

<table>
<thead>
<tr>
<th>Crop</th>
<th>1879</th>
<th>1889</th>
<th>1899</th>
<th>1909</th>
<th>1919</th>
<th>1929</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Acres</td>
<td>Acres</td>
<td>Acres</td>
<td>Acres</td>
<td>Acres</td>
<td>Acres</td>
<td>Acres</td>
</tr>
<tr>
<td>Corn</td>
<td>30,456</td>
<td>31,491</td>
<td>35,185</td>
<td>33,501</td>
<td>29,916</td>
<td>25,048</td>
<td>23,029</td>
</tr>
<tr>
<td>Oats</td>
<td>11,457</td>
<td>13,482</td>
<td>6,690</td>
<td>3,749</td>
<td>5,156</td>
<td>523</td>
<td>486</td>
</tr>
<tr>
<td>Wheat</td>
<td>13,683</td>
<td>8,801</td>
<td>12,774</td>
<td>6,186</td>
<td>11,552</td>
<td>3,722</td>
<td>6,824</td>
</tr>
<tr>
<td>Rye</td>
<td>433</td>
<td>157</td>
<td>67</td>
<td>65</td>
<td>170</td>
<td>47</td>
<td>128</td>
</tr>
<tr>
<td>Barley</td>
<td>266</td>
<td>31</td>
<td>59</td>
<td>10</td>
<td>74</td>
<td>49</td>
<td>15</td>
</tr>
<tr>
<td>Buckwheat</td>
<td>23</td>
<td>12</td>
<td>5</td>
<td>28</td>
<td>5</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td>107</td>
<td>51</td>
<td>6</td>
<td>371</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td>2,621</td>
<td>8,535</td>
<td>10,950</td>
<td>13,084</td>
<td>12,876</td>
<td>13,664</td>
<td>17,939</td>
</tr>
<tr>
<td>Timothy and/or timothy and clover mixed</td>
<td></td>
<td>10,602</td>
<td>8,020</td>
<td>11,394</td>
<td>8,325</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clover</td>
<td>2,802</td>
<td>523</td>
<td>1,338</td>
<td>662</td>
<td>1,327</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lespedeza hay</td>
<td>3</td>
<td>13</td>
<td>72</td>
<td>59</td>
<td>460</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>2,344</td>
<td>954</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Millet or Hungarian grass</td>
<td>4,712</td>
<td>518</td>
<td>2,153</td>
<td>996</td>
<td>964</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other cultivated grasses</td>
<td>41</td>
<td>67</td>
<td>245</td>
<td>38</td>
<td>294</td>
<td></td>
<td></td>
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<tr>
<td>Wild, salt, or prairie grasses</td>
<td>1,048</td>
<td>317</td>
<td>379</td>
<td>157</td>
<td>1,353</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grains cut green</td>
<td>369</td>
<td>358</td>
<td>151</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legumes cut for hay</td>
<td>61</td>
<td>87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silage crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorghums cut for silage, hay, or fodder</td>
<td>148</td>
<td>185</td>
<td>15,060</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse forage</td>
<td>387</td>
<td>520</td>
<td>690</td>
<td>665</td>
<td>811</td>
<td>817</td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td>194</td>
<td>223</td>
<td>283</td>
<td>192</td>
<td>152</td>
<td>96</td>
<td>145</td>
</tr>
<tr>
<td>Sweetpotatoes and yams</td>
<td>1,519</td>
<td>94</td>
<td>130</td>
<td>96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other vegetables</td>
<td>135</td>
<td>24</td>
<td>70</td>
<td>97</td>
<td>148</td>
<td>723</td>
<td>2,995</td>
</tr>
<tr>
<td>Tobacco</td>
<td>547</td>
<td>452</td>
<td>615</td>
<td>842</td>
<td>126</td>
<td>233</td>
<td></td>
</tr>
<tr>
<td>Sorghum cane</td>
<td>1</td>
<td>11</td>
<td>22</td>
<td>25</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strawberries</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raspberries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackberries and dewberries</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apples</td>
<td>85,503</td>
<td>131,723</td>
<td>124,570</td>
<td>111,657</td>
<td>84,720</td>
<td>74,443</td>
<td>84,158</td>
</tr>
<tr>
<td>Peaches</td>
<td>59,340</td>
<td>4,017</td>
<td>14,644</td>
<td>46,733</td>
<td>25,137</td>
<td>8,465</td>
<td></td>
</tr>
<tr>
<td>Pears</td>
<td>491</td>
<td>971</td>
<td>4,709</td>
<td>12,934</td>
<td>10,895</td>
<td>5,646</td>
<td></td>
</tr>
<tr>
<td>Plums and prunes do</td>
<td>289</td>
<td>2,146</td>
<td>2,292</td>
<td>1,997</td>
<td>656</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cherries</td>
<td>535</td>
<td>1,740</td>
<td>4,342</td>
<td>6,378</td>
<td>4,254</td>
<td>4,421</td>
<td></td>
</tr>
<tr>
<td>Grapes</td>
<td>1,069</td>
<td>1,012</td>
<td>1,700</td>
<td>887</td>
<td>1,639</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Cowpeas.  4 Corn.
2 Soybeans.  5 Less than 1 acre.
3 Sweetclover.

cropland; but complete fertilizer, as 4-12-4 or 3-12-6, is now used more often, and the trend is toward high-analysis fertilizer.

The grades and quantities of fertilizers used in the production of many of the crops of the county are shown in table 4.

* Percentages, respectively, of nitrogen, phosphoric acid, and potash.
A. Corn on Hagerstown silt loam, rolling phase, one of the most productive upland soils.

B. Tobacco plant bed protected by a cloth cover until plants are large enough to be transplanted in the field.

C. Chert-free limestone area in foreground is characterized by numerous stony outcrops, sinkholes, and choppy relief. Areas productive of crops are in general on Emory soil on small irregular colluvial slopes. Stony areas unsuited to tillage afford good pasture and occupy most of the remaining limestone belt. Loud and Frederick soils chiefly comprise the partly forested cherty ridges in center.
A. Rolling stony land (limestone material) is used almost wholly for pasture. Bluegrass and white clover commonly predominate in the shade of black walnut trees, and broomsedge in the open area; the same relation appears to exist between black locust trees and sod vegetation.

B. Purebred sire used for breeding beef cattle.
<table>
<thead>
<tr>
<th>Crop</th>
<th>Fertilizer used on most farms</th>
<th>Fertilizer used on many farms</th>
<th>Fertilizer used on few farms</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Formula</td>
<td>Pounds</td>
<td>Formula</td>
</tr>
<tr>
<td>Corn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rye</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobacco</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 About 15 pounds of borax an acre is added in a few fields; 3 to 6 tons of lime are generally applied when seeded, and 1 to 2 tons as top dressing every 2 or 3 years. When differences in growth begin to appear, either muriate of potash or an 0-12-12 mixture is applied as a top dressing.

2 Supplemented with manure.

3 Side-dressed on some farms with 50 to 150 pounds of 50-percent muriate of potash an acre; on others with 50 to 150 pounds of nitrate of soda and an 0-10-4 mixture.
Lespedeza is not generally fertilized or limed, but in some fields it is top-dressed in spring with 150 to 200 pounds an acre of 20-percent superphosphate or a 0–10–4 mixture. Although red clover is not usually fertilized, in some fields it is given a top dressing similar to that given lespedeza, and is limed with about 2 tons an acre of ground limestone. Vegetables and strawberries are fertilized with 150 to 300 pounds of a 4–12–4 mixture, supplemented with manure. On some farms these crops are side-dressed with muriate of potash or nitrate of soda when differences in plant growth appear.

Until about 1935 pastures were fertilized by only a few farmers. Farmers who fertilized their pastures increased pasture yield and improved the quality of pasture plants. The fertilizers most often used are 20- and 45-percent superphosphate. A 4–12–4 mixture is applied in some pastures, and a 0–12–5 mixture in a few.

PERMANENT PASTURES

Reports in 1939 showed 45,860 acres in pasture land. In the limestone belts much steep and stony land is used for pasture (pls. 3, C and 4, A). Although some of this stony land has gentle slopes, much of it is hilly and steep. In the mountainous areas underlain by non-calcareous sandstone and shale, only a comparatively small acreage of the soil is used for pasture.

A large proportion of the farms have permanent pastures, largely on soils unsuitable for field crops, although pastures are found on some of the larger and more productive farms in some areas that are suitable for field crops.

The larger and more productive permanent pastures are in Rye Cove, in the valley of Big Moccasin Creek, and on the north slope of Clinch Mountain. In these areas soils of the Hagerstown, Pisgah, Carbo, Hayter, Westmoreland, and Tumbez series are used to some extent for permanent pasture. Bluegrass, crabgrass, white clover, and broomsedge are the main pasture plants on these soils.

The less extensive and less productive pastures are on Moccasin Ridge, Newman Ridge, Purchase Ridge, and in the southeastern part of the county. The soils on which these pastures are located include members of the Frederick, Elliber, Clarksville, and Tellico series, and the very fine sandy loam and stony silty clay loam of the Carbo series. Broomsedge and some bluegrass, white clover, and crabgrass are the main pasture plants. Dewberry and smilax are common vegetation in the pastures.

The least extensive and least productive permanent pastures are in the northern part of the county and in Poor Valley. They are on soils of the Muskingum (pl. 5, A), Dekalb, Montevallo, Jefferson, Monongahela, Philo, and Atkins series. Poverty oat grass, lespedeza, plantain, smilax, and hawkweed are the principal plants in the pastures, and bluegrass and white clover are sparse.

Soils on north and east slopes grow the thickest stands of pasture plants. In many areas the south and west slopes are badly eroded, especially on Clinch Mountain on pastured areas of Westmoreland and Carbo soils. Many permanent pastures, including some on the poorest soils, have been improved since about 1935 by good practices of management.
LIVESTOCK AND LIVESTOCK PRODUCTS

Livestock and livestock products are important in the agriculture. In 1940 domestic animals were valued at $1,175,501 and livestock products sold or traded at $190,810.

On April 1, 1940, the number of cattle on farms was 16,177, of which 7,803 were cows and heifers 2 years old or older. Cattle and calves showed an increase of 2,021 over the number reported for April 1, 1930, hogs and pigs an increase of 999, and sheep and lambs a decrease of 1,660. According to the county agricultural agent, the number of hogs raised is not sufficient for local demands, and many hogs are bought in neighboring counties.

The number of all chickens sold in 1939 was 91,603, and the number of eggs produced, 779,601 dozen. There were 2,139,274 gallons of milk produced, of which 43,197 gallons were sold. Butterfat sold amounted to 41,884 pounds; butter sold, 68,783 pounds; and butter churned, 483,865 pounds. The wool produced totaled 16,517 pounds, and honey, 13,693 pounds.

On the average farm the livestock consists of three or four cows, several calves, a team of horses or mules, and enough hogs and chickens to meet home needs.

Shorthorn and Aberdeen Angus are bred, but most of the beef cattle are Herefords. Much improvement has been made in the quality of the beef cattle since 1928 by the introduction of several purebred Hereford and Shorthorn sires (pl. 4, B). The milk cows are mostly Jerseys and Guernseys.

The sheep are Hampshire and grade Hampshire. Many purebred Hampshire sires are owned in the county.

Both horses and mules are used as work animals. Between 1930 and 1940 the number of horses and colts increased 8 percent, and the number of mules and mule colts decreased 33.4. On April 1, 1940, there were 4,000 horses and 828 mules 3 months old, or older—an average of one horse or mule for each 11.6 acres of cropland harvested in 1939. The horses are mostly of Suffolk and Percheron breeds. Some horses and mules raised in the county are sold at markets in the South.

The number and value of domestic animals in the county in stated years are shown in table 5.

Although much hay and grain are produced, feed is purchased on many farms. According to the county agricultural agent considerable dairy feed is purchased from nearby counties. From 1909 to 1939, according to Federal census reports, the average amount spent for feed was $43.76 a farm. In 1939, 1,499 farms purchased feed, averaging $26.66 each.

TYPES OF FARMS

Of the 3,874 farms in the county, 2,955 (76.3 percent) are of the subsistence type, or farms on which most of the farm products are used by the farm household; 753 (19.4 percent) derive their principal income from field crops; and 109 (2.8 percent) from livestock. Of the remainder, each group comprising less than 1 percent of the total, 13 derive their main income from poultry and poultry products, 9 from forest products, 4 from dairy products, and 2 from fruits and nuts. There were 17 farms on which no farm products were sold, traded, or used; and 12 were not classified.
### Table 5.—Number and value of livestock on farms and ranges of Scott County, Va., in stated years

<table>
<thead>
<tr>
<th>Livestock</th>
<th>1920 ¹</th>
<th>1930 ²</th>
<th>1940 ²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Value</td>
<td>Number</td>
</tr>
<tr>
<td>Horses</td>
<td>5,207</td>
<td>$449,340</td>
<td>3,680</td>
</tr>
<tr>
<td>Mules</td>
<td>1,708</td>
<td>183,001</td>
<td>1,244</td>
</tr>
<tr>
<td>Cattle</td>
<td>18,464</td>
<td>839,426</td>
<td>14,156</td>
</tr>
<tr>
<td>Sheep</td>
<td>5,379</td>
<td>54,015</td>
<td>5,849</td>
</tr>
<tr>
<td>Goats</td>
<td>105</td>
<td>427</td>
<td>173</td>
</tr>
<tr>
<td>Swine</td>
<td>11,829</td>
<td>107,037</td>
<td>4,675</td>
</tr>
<tr>
<td>Chickens</td>
<td>193,122</td>
<td>203,264</td>
<td>162,383</td>
</tr>
<tr>
<td>Other poultry</td>
<td>11,652</td>
<td>3,217</td>
<td>14,959</td>
</tr>
</tbody>
</table>

¹ Animals of all ages on Apr. 1.
² Animals on Apr. 1, excluding horses, mules, and cattle under 3 months; swine, goats, and chickens under 4 months; and sheep under 6 months of age.

### Land Use

In 1939, according to the Federal census, 250,337 acres (72.6 percent of the county) was in farms. Of the land in farms 62,919 acres (25.1 percent) was in cropland, including land on which crops failed and idle or fallow land; 60,398 acres (24.1 percent) in plowable pasture; 81,160 acres (32.5 percent) in woodland; and 45,860 acres (18.3 percent) in all other land. The nonfarm land was mostly cut-over forested land, largely in mountainous parts of the county. Forested land covered 27.4 percent of the county, and woodland in farms 23.5 percent—a total of 50.9 percent of the county.

In 1940 the farms ranged in size from less than 10 acres to more than 1,000. Of the 3,874 farms, 1,397 contained 29 acres or less, 2,097 contained 30 to 139, 360 contained 140 to 499, and 20 contained 500 to more than 1,000.

The classification of farms by size, number, total acreage in 1940, and acreage of cropland harvested in 1939 is shown in table 6.

The small farms are located in the better agricultural districts and in districts of steep hilly relief. Most of the large farms are in Rye Cove, on Copper and Moccasin Ridges, in the valley of Moccasin Creek, and near the Clinch River, the North Fork Clinch River, and the North Fork Holston River. One of the largest farms in the county is located near Nickelsville.

The number of farms in 1940 was 57.6 greater than in 1880; the proportion of land area in farms was 11.9 percent less; the average size of farms was 44.1 percent less; the proportion of improved land in farms was 7 percent greater; and the average acreage of improved land in farms was 31.9 percent less. The population of the county was 26,989 in 1940, an increase of 56.6 percent over that in 1880.

The number of farms, proportion of land in farms, average size of farms, and proportion and average acreage of improved farm land are given in table 7.

The combined acreage of corn, tobacco, potatoes, and sweetpotatoes in 1939 was 26,986 and in 1929 the combined acreage was 26,671, or an increase of 315 acres in the decade. The aggregate acreage of wheat,
Table 6.—Classification of farms according to size, number of farms, total acreage in 1940, and acreage of cropland harvested in 1939 in each group

<table>
<thead>
<tr>
<th>Size of farms</th>
<th>Farms</th>
<th>Total acreage in 1940</th>
<th>Cropland harvested in 1939</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Acres</td>
<td>Acres</td>
</tr>
<tr>
<td>Under 10</td>
<td>448</td>
<td>2,592</td>
<td>1,870</td>
</tr>
<tr>
<td>10 to 29</td>
<td>949</td>
<td>17,787</td>
<td>8,336</td>
</tr>
<tr>
<td>30 to 49</td>
<td>873</td>
<td>29,222</td>
<td>8,700</td>
</tr>
<tr>
<td>50 to 69</td>
<td>510</td>
<td>29,535</td>
<td>7,447</td>
</tr>
<tr>
<td>70 to 90</td>
<td>450</td>
<td>36,932</td>
<td>8,116</td>
</tr>
<tr>
<td>100 to 139</td>
<td>374</td>
<td>42,759</td>
<td>8,381</td>
</tr>
<tr>
<td>140 to 179</td>
<td>145</td>
<td>22,653</td>
<td>3,833</td>
</tr>
<tr>
<td>180 to 219</td>
<td>94</td>
<td>18,530</td>
<td>2,553</td>
</tr>
<tr>
<td>220 to 259</td>
<td>49</td>
<td>11,502</td>
<td>1,874</td>
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<tr>
<td>260 to 379</td>
<td>56</td>
<td>17,559</td>
<td>2,546</td>
</tr>
<tr>
<td>380 to 499</td>
<td>16</td>
<td>6,558</td>
<td>595</td>
</tr>
<tr>
<td>500 to 699</td>
<td>16</td>
<td>8,974</td>
<td>1,416</td>
</tr>
<tr>
<td>700 to 999</td>
<td>2</td>
<td>5,734</td>
<td>219</td>
</tr>
<tr>
<td>1,000 and over</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

oats, barley, rye, hay, and forage was 25,979 in 1939, and 18,011 in 1929, a reduction of 7,968 acres. The census figures indicate an increase in intertilled and close-growing crop acreages in 1939 over those of 1929.

FARM TENURE

In 1940, 2,612 farms (67.4 percent) were operated by full owners; 302 (7.8 percent) by part owners; and 959 (24.8 percent) by tenants. There were 103 cash tenants, 5 share-cash tenants, 746 share tenants and croppers, and 105 other tenants. From 1880 to 1940, the average proportion of tenancy was 32.3 percent. The greatest proportion of tenancy, 38 percent, was in 1880 and in 1900, and the smallest, 24.8 percent, in 1940.

Table 7.—Number, average size, and proportionate extent of farms and percentage and average acreage of improved farm land in Scott County, Va., in stated years

<table>
<thead>
<tr>
<th>Year</th>
<th>Farms</th>
<th>Average size of farms</th>
<th>Proportion of land area in farms</th>
<th>Improved farm land</th>
<th>Average improved land per farm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Acres</td>
<td>Percent</td>
<td>Percent</td>
<td>Acres</td>
</tr>
<tr>
<td>1880</td>
<td>2,458</td>
<td>116.0</td>
<td>81.7</td>
<td>40.4</td>
<td>46.7</td>
</tr>
<tr>
<td>1890</td>
<td>2,701</td>
<td>118.0</td>
<td>91.7</td>
<td>41.9</td>
<td>49.4</td>
</tr>
<tr>
<td>1900</td>
<td>3,435</td>
<td>86.6</td>
<td>85.6</td>
<td>50.3</td>
<td>43.5</td>
</tr>
<tr>
<td>1910</td>
<td>3,998</td>
<td>85.8</td>
<td>98.7</td>
<td>48.0</td>
<td>41.2</td>
</tr>
<tr>
<td>1920</td>
<td>3,696</td>
<td>75.6</td>
<td>80.4</td>
<td>58.7</td>
<td>44.4</td>
</tr>
<tr>
<td>1930</td>
<td>3,791</td>
<td>67.2</td>
<td>73.3</td>
<td>39.8</td>
<td>26.8</td>
</tr>
<tr>
<td>1940</td>
<td>3,874</td>
<td>64.6</td>
<td>72.6</td>
<td>49.3</td>
<td>31.8</td>
</tr>
</tbody>
</table>
Cropland harvested by full owners in 1939 was 30,358 acres, by part owners 5,307 acres, and by tenants 11,221 acres. Of the cropland harvested by tenants, 738 acres were harvested by cash tenants, 41 acres by share-cash tenants, 9,618 acres by share tenants and croppers, and 824 by other tenants. Under the share system, the tenant receives either one-third or one-half of the yield.

Nearly all the farm laborers are white. Cash wages paid for hired labor, exclusive of housework and contract construction work, by 810 farms totaled $59,135 in 1939. Of this amount, $2,680 was for labor hired by the month on 27 farms; $53,855 for labor hired by the day or week on 781 farms; and $2,500 for other hired labor, including piecework and contract labor, on 41 farms. In 1940 a total of 1,057 farm operators (27.3 percent of all) reported work off their farms in 1939 for pay or income.

FARM INVESTMENTS

The total value of the farms of Scott County in 1940, including land and buildings, was $9,145,992, and the total value of buildings on 3,758 farms was $2,700,612. The average value of land and buildings per farm was $2,361; of land and buildings per acre, $36.53. The average value of farms of 30 acres or more was $8,141. In 1880 the value of all property per farm was $904, 82.7 percent of which was in land, fences, and buildings.

The value of farms, including land and buildings, operated by full owners in 1940 was $7,107,713; by part owners, $675,187; and by tenants, $1,363,092. The value of buildings on 2,561 farms operated by full owners was $2,126,805; on 294 farms by part owners, $185,845; and on 903 farms by tenants, $396,962.

In 1940 the value of implements and machinery on 2,016 farms was $287,769, and the total value of domestic animals on farms was $1,175,301. The value of implements and machinery on 1,497 farms operated by full owners was $220,930; on 189 by part owners, $28,958; and on 330 by tenants, $37,881.

Farm machinery and implements on the better situated farms include two or three turning plows, single and double cultivators, drag, manure spreader, grain drill, single- or double-row corn planter, grain binder, mowing machine, two-horse wagon, pick-up truck, scythes, hand rakes, hand hoes, and brier hooks. A few of the better farms also are equipped with a tractor, corn cutter, hay rakes, and hay drags. The better equipment is used on farms where the character of the soil and the slope of the land permit. Areas favorable for the use of such equipment are on bottoms and terraces near the Clinch River, the North Fork Clinch River, the North Fork Holston River, and in Rye Cove. Farm machinery and implements in the hilly and steep parts of the county, where a large proportion of the farms are situated, include a hillside plow, a spike-tooth harrow, two single-row cultivators, a single-row corn planter, hand hoes, and grubbing tools. Some of these farms do not have a corn planter.

In 1940, of the 2,613 farms reported to be operated by full owners, 2,298 were free from mortgage, 234 were mortgaged, and on 81 there was no mortgage report. The proportion of mortgaged farms was 9 percent, as compared to 28.7 percent for the State.
SOIL SURVEY METHODS AND DEFINITIONS

In making a soil survey the soils are examined, classified, and mapped in the field and their characteristics recorded, particularly in regard to the growth of various crops, grasses, and trees.

The soils and underlying formations are examined systematically in many locations. Test pits are dug, borings made, and highway or railroad cuts and other exposures studied. Each reveals a series of distinct soil layers, or horizons, termed collectively the soil profile. Each horizon, as well as the underlying parent material, is studied in detail, and the color, structure, porosity, consistency, texture, and content of organic matter, roots, gravel, and stone are noted. The chemical reaction of the soil and its content of lime and salts are determined by simple tests. Other features taken into consideration are drainage, both internal and external, the relief, or lay of the land, and the interrelations of soil and vegetation.

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 to the production of crop plants, grasses, and trees. On the basis of these characteristics, the soils are grouped in the following classification units: (1) Series, (2) types, (3) phases, (4) complexes, and (5) miscellaneous land types.

The series is a group of soils having the same genetic horizons, similar in important characteristics and arrangement in the soil profile, and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage, and other important internal characteristics 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 series are given geographic names taken from localities near which they were first identified. Pisgah, Frederick, and Hayter are names of important soil series in Scott 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 this texture—sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, or clay—is added to the series designation to give a complete name to the soil type. Hayter loam and Hayter fine sandy loam are soil types within the Hayter series. Except for the texture of the surface soil these types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the unit to which agronomic data are definitely related. In comparisons of the type and phases of that type, to avoid the repetition of their complete names, the soil taking the type name is sometimes referred to as the normal phase.

A soil phase specifically named is a variation within the type, differing from the normal phase of the type in some feature, generally ex-

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1 The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the chemical reaction. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.
ternal, that may be of special practical significance but not differing
in the major characteristics of the soil profile. For example, within
the total range of relief of a soil type some areas may have slopes that
allow the use of machinery and the growth of cultivated crops and
others may not. Differences in relief and degree of accelerated erosion
may be shown as phases. Even though no important differences may
be apparent in the soil profile or in its capability for the growth of
native vegetation throughout the range in relief, there may be im-
portant differences in respect to the growth of cultivated crops. In
such instances the more sloping parts of the soil type may be shown
on the map as a sloping or a hilly phase. Frederick cherty silt loam,
steep phase, is an example of a phase in the Frederick series.

In some places, two or more soil units may be in such intimate or
mixed pattern that they cannot be clearly shown separately on a small-
scale map, but must be mapped as a complex.

Examples of soil complexes are found in the Frederick-Ellipher
stony silt loams, and in the Teas Dandridge and Teas-Litz silt loams.

Some areas of land that have little or no true soil are termed miscel-
aneous land types. Examples in this county are Limestone rockland,
Riverwash, and Stony alluvium (Pope soil material).

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

Texture refers to the relative amounts of clay, silt, and various
grades of sand that make up the soil mass. Light-textured soils con-
tain much of the coarser separates (sands), and heavy-textured soils
contain much clay. Structure refers to the morphological aggregates
in which the individual soil particles are arranged. Consistence refers
to such conditions as friability, plasticity, stickiness, hardness, com-
 pactness, toughness, and cementation. Permeability and perviousness
connote the ease with which water, air, and roots penetrate the soil.

Surface soil ordinarily refers to the lighter textured surface layer,
which extends usually to a depth of 6 to 12 inches. The subsoil is the
deeper and heavier textured layer, which is usually of a uniform color
in well-drained soils. The substratum, or soil material layer, is be-
neath the subsoil and is characteristically splotched or mottled with
two or more colors. Bedrock, as used here, is consolidated rock upon
which the substratum rests.

In a practical sense, the degree of acidity may be thought of as the
degree of poverty in lime (available calcium). An alkaline soil in
this county is rich in available calcium, a neutral soil contains a suf-
ficient quantity for any crop commonly grown, and an acid soil is
generally low in lime.

Workability refers to the ease with which tillage, harvesting, and
other farming operations can be accomplished. Conservability refers
to the ease with which productivity and workability can be maintained
or improved. Major factors considered are the ease with which soil
material and plant nutrients are conserved, and good tilth maintained.
Productivity refers to the capacity of the soil to produce crops under
prevailing practices of farming.
A. Where the soils are developed over sandstone and shale, the areas suitable for crops are limited chiefly to bottoms and colluvial slopes. Pope and Philo soils predominate on the creek bottom, Jefferson soils on the colluvial slopes to the right, and Muskingum soils in the background.

B. Moderately broad bottom land of well-drained Pope soils along a creek issuing from an extensive area of Muskingum soils.

C. Nearly level river bottom of Sequatchie fine sandy loam in a landscape predominantly of the unproductive Teas-Latz soils and rough stony land types.
A. Hilly areas well suited to pasture and hay crops: Alfalfa occupies much of the low hills in foreground on Carbo and Chilhowie soils and permanent pasture a great part of the steeper cleared slopes on the high hills in background on Frederick, Bolton, Elliber, and Clarksville soils. The smooth area of Greendale soil in foreground is used in a rotation of corn, small grain, and hay.

B. Landscape typical of the cherty ridges, on which Lodi, Frederick, Elliber, Bolton, and Clarksville soils predominate.

C. Area of Chilhowie stony clay, severely eroded steep phase, which is unsuited to row crops and is of moderately low productivity for pasture.
SOILS

Nearly all the soils of Scott County contain three layers—the surface layer, the subsoil, and the substratum, or parent material. In most places the surface layer is lighter in texture than the subsoil, where the fine soil particles are concentrated. The subsoil is underlain by the substratum, which consists of weathered rock, colluvial material deposited at the base of slopes, or friable alluvial material deposited near streams. In some places the substratum is more friable than the subsoil, but in others it has a heavier texture. The soil layers are variable in thickness, the surface layer ranging from 3 to 15 inches, the subsoil from 12 to 40, and the substratum from a few inches to 35 or more. In some places no subsoil has developed and the surface layer grades into decomposed rock; in others no substratum is present and the subsoil lies directly on bedrock. In general, the soils of the uplands having the greatest depth are over limestone, and those of least depth are over shale and sandstone.

The surface and subsoil layers are brown, yellow, and red, or shades of these colors. The texture of the surface layer is largely of fine soil particles and consists of silt loam, loam, fine sandy loam, very fine sandy loam, silty clay loam, or clay. The silty clay loam and the clay are the heaviest textures in the county. Although the surface layer can be worked to a good tilth nearly everywhere, heavy draft animals are necessary for plowing many of the soils. The subsoil is mainly friable but in some soils tough or plastic. Its texture is silty clay loam, silty clay, fine sandy clay, or very fine sandy clay, but in some, clay, heavy loam, silt loam, or fine sandy loam. Most of the farmed soils are retentive of moisture and plant nutrients and can be built up and kept in a good state of productivity.

No large quantity of organic matter has accumulated in the soils. Since they were formed mainly under forest cover, conditions were not so favorable to the accumulation of organic matter as in grasslands. Forested areas contain a thin layer of forest litter and leafmold on the surface. A small quantity of decayed organic matter is found in the first inch or two of the surface layer of such soils as well as in pastures not often plowed. A moderate quantity is found in the surface layer of soils of the Pisgah, Bolton, Emory, and Sequatchie series.

Most of the soils are slightly to very strongly acid. In low bottoms near streams some are mildly alkaline, a condition caused by an accumulation of lime carbonate or by lime water from limestone formations at the margin of the stream bottoms. In a few areas on the uplands the soil is calcareous.

Surface relief in the county ranges from almost level, sloping, rolling, and hilly to steep and very steep. Areas having nearly level, gently undulating, and undulating to gently sloping relief, with slopes ranging from almost none to about 8 percent, include bottom land, some terrace land near streams, and smooth land near the base of slopes. Areas with sloping and rolling relief (slopes ranging from about 8 to 15 percent) are on stream terraces, on colluvial slopes, and on valley uplands. Much of the valley upland and to some extent the lower slopes of mountains have very strongly sloping and hilly relief (15 to 30 percent slopes). Lands having steep relief (30 to 80 percent slopes), occupy some of the valley country and much of the
mountain country. Land of steep and very steep slopes (60 percent or more) includes some valley and much mountainous country.

Many rock fragments that have rolled from mountainsides are found on the valley uplands near the base of mountains. In some places they are few but in others numerous enough to preclude cultivation. On some of the valley ridges chert fragments are so numerous as to hinder cultivation. In places on valley slopes and ridges many small outcrops of limestone bedrock render the land unfit for any agricultural use except pasture. Sinks, some too deep to cultivate, have formed in certain localities.

The character of the surface relief and the presence of rocks usually determine the use that can be made of the land. Nearly all the steep land cleared of forest and the cleared land having many outcrops of limestone is used for pasture. Most of the steeper land is covered with second-growth forest. The cropland is confined mainly to the smoother valley uplands and to colluvial slopes, stream terraces, and bottoms near streams.

SOIL SERIES AND THEIR RELATIONS

The soils of Scott County vary in extent and are classified in 38 series on the basis of differences in characteristics. Because of small extent, unfavorable use suitability, or both, the soils of some of these series are of little importance to agriculture. Knowledge of the soil series, especially those that include important soils, and of their relations is helpful in making use of the soil survey. Such knowledge probably can be most readily obtained by associating the soils of each series with the position they occupy on prominent features of the landscape.

To this end the series are grouped according to their position on the major features of the landscape as follows: (1) Soils of uplands, (2) soils of colluvial lands, (3) soils of terraces, and (4) soils of bottom lands.

Uplands are those lands that lie above the adjacent stream bottoms and consist of materials derived directly from the decay of the underlying rocks. Colluvial lands are on colluvial slopes or toe slopes in the uplands and include land derived from material accumulated from the higher slopes. Terraces are water-made benchlike features bordering on stream bottoms but on a higher elevation and not subject to flooding. Bottom land consists of water-borne material on first bottoms near streams and is subject to overflow by the adjacent streams.

The soil series associated with each of these prominent features of the landscape and the main characteristics of each are shown in table 8.

SOILS OF UPLANDS

The soils of uplands include those developed on both valley and mountain uplands. Agriculture is largely confined to valley uplands where the surface relief is more favorable to cultivation and where the soil is deeper than on the mountains (pl. 6, 4). A large part of the valley country is underlain by limestone and by limestone and shale mixed, which through weathering have furnished mineral material for large areas of soils.
Colluvial materials have given rise to soils of a considerable aggregate area near the foot of slopes of valley uplands, and alluvial material deposited by running water to a fairly large aggregate area in many places near streams in the valleys. The soils derived from colluvial and alluvial materials are associated with those of the valley uplands in many places and, together with the better soils developed from the residuum of rocks weathered in place, largely determine the distribution of farms and the character of the agriculture of the county.

On the mountains and on the mountain foothills are large areas of steep, rough, or broken country where the soils are comparatively shallow to bedrock and are strewn with rock fragments, which in many places are mixed with the soil. Large boulders and bedrock outcrops appear. On some lower slopes and a few ridges the soil is of sufficient depth for cultivation, but in practically all the mountainous country cultivation is precluded by steep slopes and stoniness. Although the soil on some mountain slopes is used for pasture, most of the mountain land is in forest, consisting largely of second-growth trees, and is underlain by noncalcareous sandstone and shale.

The upland surface relief is marked by fairly smooth, hilly, knobby, and ridgy valley uplands (pl. 6, B); and by strongly sloping, steep, and broken mountain uplands. The rock formations also are varied and range from limestone of high-calcic content to noncalcareous sandstone. Between these rock extremes there are different grades of limestone and various shales and sandstone. Thus, on varied surface relief and over many kinds of rocks, many different soils have developed, which are classified in the following series:

| Bolton | Litz       |
| Carbo  | Lodl       |
| Chilhowie | Montevallo |
| Clarksville | Muskingum  |
| Dandridge | Pisgah    |
| Dekalb  | Teas       |
| Dunmore | Tellico    |
| Ellicter | Tumbez    |
| Frederick | Wellston  |
| Hagerstown | Westmoreland |
| Lehew    |            |

SOILS OF COLLUVIAL LANDS

Soils formed from colluvial material derived from mountain slopes and accumulated on valley floors are members of the Hayter, Jefferson, and Allen series. This colluvial material is found in several parts of the county at the base of mountain slopes or spread over valley uplands for some distance from the mountains. It consists of angular and subangular sandstone fragments, shale fragments, and possibly other rock waste, and ranges from a few feet 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 limestone. Soils of the Hayter series have probably been affected by materials from calcareous sources, but the Jefferson and Allen soils are derived from noncalcareous sources.

Soils formed from colluvial material consisting of rainwash and slough that accumulated at the bases of adjacent slopes are members of the Emory, Burgin, Greendale, Camp, and Leadvale series. The
Emory, Burgin, and Greendale soils have formed from materials washed or slumped from soils underlain by limestone, the Camp soils from materials from soils underlain by shale and limestone mixed, and the Leadvale soils from materials from soils underlain by noncalcareous sandstone and shale. The soils of colluvial lands are classified in the following series:

<table>
<thead>
<tr>
<th>Allen</th>
<th>Greendale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burgin</td>
<td>Hayter</td>
</tr>
<tr>
<td>Camp</td>
<td>Jefferson</td>
</tr>
<tr>
<td>Emory</td>
<td>Leadvale</td>
</tr>
</tbody>
</table>

**SOILS OF TERRACES**

In places near some of the streams of the county there are narrow to fairly broad terraces or benches, consisting of alluvial deposits of sand, silt, clay, and rock fragments derived from the uplands. Some of this alluvial material came from uplands underlain mainly by limestone and some from uplands underlain mainly by sandstone and shale. The Waynesboro and Sequatchie soils are well drained, as also are the Holston, except where internal drainage is slow in the lower part of the profile; and the Monongahela soils are imperfectly drained. The terrace soils are members of the following series:

<table>
<thead>
<tr>
<th>Holston</th>
<th>Sequatchie</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monongahela</td>
<td>Waynesboro</td>
</tr>
</tbody>
</table>

**SOILS OF BOTTOM LANDS**

The latest alluvial deposits are in first bottoms near some of the streams and occupy nearly level positions only a few feet higher than the normal level of the streams. In some areas they consist of material derived from uplands underlain mainly by limestone and in others of material derived from uplands underlain mainly by noncalcareous sandstone and shale. All of these soils are subject to overflow by the adjacent streams during heavy rains.

Differences among the series of this group are largely due to differences in the character of the parent material of the soils and to differences in drainage. Alluvial material derived from uplands underlain mainly by limestone has given rise to soils of the Lindside and Melvin series. The Lindside soil is imperfectly drained, and the Melvin soil poorly drained. Alluvial material derived mainly from uplands underlain by noncalcareous sandstone and shale has given rise to soils of the Pope, Philo, and Atkins series. The Pope soils are well drained, the Philo imperfectly, and the Atkins poorly drained. The soils of the bottom lands are members of the following series:

<table>
<thead>
<tr>
<th>Atkins</th>
<th>Philo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lindside</td>
<td>Pope</td>
</tr>
<tr>
<td>Melvin</td>
<td></td>
</tr>
</tbody>
</table>

**SOIL SERIES, TYPES, AND PHASES**

The soils of Scott County are classified in 100 soil types, phases, and complexes. In addition, nine miscellaneous land types are listed: Alluvial soils, undifferentiated; Limestone rockland; Riverwash; Rolling stony land (limestone material); Rough gullied land (limestone and shale materials); Rough stony land (limestone material); Rough stony land (Muskimgum soil material); Sandstone rockland; and Stony alluvium (Pope soil material).
The soils of the county are described in detail and their agricultural relations discussed. Their location and distribution are shown on the accompanying map, and their acreage and proportionate extent are given in table 9.

**Table 9.—Acreage and proportionate extent of the soils mapped in Scott County, Va.**

<table>
<thead>
<tr>
<th>Soil ¹</th>
<th>Acres</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen fine sandy loam</td>
<td>333</td>
<td>0.1</td>
</tr>
<tr>
<td>Alluvial soils, undifferentiated</td>
<td>934</td>
<td>.3</td>
</tr>
<tr>
<td>Atkins fine sandy loam</td>
<td>1,101</td>
<td>.3</td>
</tr>
<tr>
<td>Bolton loam</td>
<td>5,734</td>
<td>1.7</td>
</tr>
<tr>
<td>Eroded steep phase</td>
<td>832</td>
<td>.2</td>
</tr>
<tr>
<td>Rolling phase</td>
<td>1,338</td>
<td>.4</td>
</tr>
<tr>
<td>Steep phase</td>
<td>6,844</td>
<td>2.0</td>
</tr>
<tr>
<td>Very steep phase</td>
<td>1,485</td>
<td>.4</td>
</tr>
<tr>
<td>Burgin silty clay loam</td>
<td>262</td>
<td>.1</td>
</tr>
<tr>
<td>Camp silt loam</td>
<td>653</td>
<td>.2</td>
</tr>
<tr>
<td>Sloping phase</td>
<td>1,754</td>
<td>.5</td>
</tr>
<tr>
<td>Carbo silt loam</td>
<td>1,120</td>
<td>.3</td>
</tr>
<tr>
<td>Steep phase</td>
<td>499</td>
<td>.1</td>
</tr>
<tr>
<td>Carbo silty clay loam</td>
<td>672</td>
<td>.2</td>
</tr>
<tr>
<td>Rolling phase</td>
<td>512</td>
<td>.1</td>
</tr>
<tr>
<td>Carbo stony silty clay loam</td>
<td>11,840</td>
<td>3.4</td>
</tr>
<tr>
<td>Rolling phase</td>
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<tr>
<td>Carbo very fine sandy loam</td>
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<td>.3</td>
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<tr>
<td>Steep phase</td>
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<tr>
<td>Chilhowie stony clay</td>
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<tr>
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See footnotes at end of table.
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<th>Soil</th>
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<td>Eroded hilly phase</td>
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<tr>
<td>Hayter fine sandy loam</td>
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<td>Hill phase</td>
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<td>0.2</td>
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<td>Hayter loam</td>
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<tr>
<td>Hill phase</td>
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<td>538</td>
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<td>Holston fine sandy loam</td>
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<tr>
<td>Jefferson fine sandy loam</td>
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<td>Montelloal silt loam</td>
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<td>Philo fine sandy loam</td>
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<td>Pope fine sandy loam 1</td>
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<td>Pope silt loam</td>
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<td>Rolling stony land (limestone material)</td>
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<td>Rough gullied land (limestone and shale materials)</td>
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<td>Rough stony land:</td>
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<td>Muskingum soil material</td>
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<td>Sandstone rockland</td>
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<td>Sequatchie fine sandy loam</td>
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</tr>
<tr>
<td>Stony alluvium (Pope soil material)</td>
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<td>Teas-Dandridge silt loams:</td>
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</tr>
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<td>Very steep phases</td>
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<tr>
<td>Teas-Litz silt loams:</td>
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<tr>
<td>Very steep phase</td>
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<td>3.3</td>
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<tr>
<td>Tellieo very fine sandy loam:</td>
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<td>Steep phase</td>
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See footnotes at end of table.
TABLE 9.—Acreage and proportionate extent of the soils mapped in Scott County, Va.—Continued

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<tr>
<th>Soil Type</th>
<th>Acres</th>
<th>Percent</th>
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</thead>
<tbody>
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<tr>
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<td>Sloping phase</td>
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<td>.2</td>
</tr>
<tr>
<td>Wellston loam, hilly phase</td>
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<td>.2</td>
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<td>Westmoreland silt loam:</td>
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<td>1.5</td>
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<tr>
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<tr>
<td>Westmoreland silty clay loam:</td>
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<tr>
<td>Total</td>
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<td>100.0</td>
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</table>

1 Where data are given for phases only, the normal type is not mapped in the county.
2 Less than 0.1 percent.
3 Small areas of made land are included.

ALLEN SERIES

The soil of the Allen series has formed on valley uplands near the base of mountains from colluvial material consisting of sandstone fragments and other rock waste derived from mountain slopes. This soil is associated with soils of the Jefferson and Hayter series and differs from them in color by having a brownish-red profile. It is acid in reaction, fairly low in content of organic matter, and moderately low in natural fertility.

The surface layer is about 7 inches thick and consists of brown friable sandy-textured soil. The subsoil is light reddish-brown to brownish-red friable heavy-textured fine sandy loam to fine sandy clay, 28 to 36 inches thick. It is underlain by brownish-red or reddish-brown friable crumbly fine sandy clay mixed with varying quantities of sandstone fragments. Only one type is mapped—Allen fine sandy loam.

Allen fine sandy loam.—This is a light-colored friable light-textured soil derived from colluvial material consisting largely of sandstone fragments that rolled from mountainsides and accumulated on valley uplands. In some places limestone underlies the fragments at a depth of 4 to 10 feet, and sinks have formed in places where the limestone has dissolved. The slopes range from 3 to 30 percent (15 to 30 percent in most places). External drainage is slow to rapid and internal drainage medium to rapid. Most of the soil is in the western part of the county in the vicinity of Pattonsville.

The 6- to 7-inch surface layer consists of brown friable fine sandy loam, light grayish brown when dry. The subsoil begins as light reddish-brown, or mingled dark reddish-brown and yellowish-brown, heavy fine sandy loam or light friable fine sandy clay and at a depth of about 10 inches changes to brownish-red friable fine sandy clay. At a depth of 32 to 38 inches the subsoil passes into brownish-red or reddish-brown friable crumbly fine sandy clay material. A few light-
gray and yellowish-brown sandstone fragments 6 to 10 inches in diameter are on the soil and in the soil. Some of these fragments are breaking down through weathering, thereby contributing sandy material to the soil.

Use and management.—Practically all of Allen fine sandy loam has been cleared of forest for agricultural use. It is easy to till and fairly easy to conserve, low in organic matter, and medium to fairly low in productivity. It is used largely for corn, wheat, and hay, with a small total acreage in pasture. Under common management, corn gives average yields of about 28 bushels an acre; wheat, 9 bushels; and timothy and clover mixed, 1 ton of hay. With common practices of management for pasture, 5 to 6 acres furnish grazing for one head of cattle.

ALLUVIAL SOILS, UNDIFFERENTIATED

The land type, Alluvial soils, undiffereniated, consists largely of recent alluvial deposits of mixed origin laid down near some of the streams. This mixed material is so recent that no definite soil has been formed from it, although in some places it is covered by soil material washed from nearby slopes. The surface relief of these mixed soils is nearly level to gently sloping, the gradient sloping to about 3 percent. External drainage is slow to very slow and internal drainage medium to slow. In most places the soils are subject to overflow from the adjacent streams. Areas of this mixed soil are in places near Bush Branch, Culberson Branch, Jesse Hollow, Balser Branch, and Timbertee Branch.

In many places the soil is brown or grayish-brown silt loam or fine sandy loam to a depth of 6 to 8 inches, where it passes into mottled or mingled brown and gray silty clay material, intermixed with small brownish-yellow chert fragments, small brown sandstone fragments, and brown shale chips. Small chert, sandstone, and shale fragments are on the surface in some places. In some poorly drained areas the soil is brown friable silt loam or silty clay loam to a depth of about 7 inches, where it changes to mottled gray and rust-brown fairly plastic silty clay. In many places the soil consists only of brown friable silt loam to a depth of about 6 inches, where it is underlain by a bed of small chert fragments.

Use and management.—Alluvial soils, undiffereniated, are very easily conserved and are medium to moderately high in productivity. Their most extensive use is for pasture land. Crabgrass, bluegrass, and various coarse grasses are the dominant pasture plants. Alder and elder bushes grow in some places in the pastures.

Under the management commonly practiced for pasture, about 3 acres of these mixed soils are sufficient to supply grazing for one head of cattle. A small total acreage is used for corn and for hay crops, consisting mainly of clover and timothy mixed and of lespedeza. Under common management, corn averages about 25 bushels and hay crops 1 ton of hay an acre.

ATKINS SERIES

The soil of the Atkins series is associated in first bottoms near streams with soils of the Pope and Philo series. It is derived from alluvial material from uplands underlain mainly by noncalcareous
sandstone and shale, is poorly drained throughout, and is acid in reaction.

The 6- to 8-inch surface layer consists of gray friable somewhat plastic soil, spotted with brown. The subsoil is gray, mottled or spotted brown, rather heavy and somewhat plastic fairly friable fine sandy clay, very fine sandy clay, or silty clay loam 16 to 18 inches thick. Beneath the subsoil there is gray, or grayish blue mottled with rust brown, heavy plastic silty clay or clay, containing some small, soft, dark-brown mineral particles in places. Atkins fine sandy loam is mapped.

Atkins fine sandy loam.—This soil is on low nearly level positions in first bottoms near streams. It was formed from sand, silt, and clay washed from uplands underlain mainly by noncalcareous sandstone and shale and deposited near the streams by running water. Both external and internal drainage are very slow, and the water table appears to be at a depth of about 18 inches. Some areas have been ditched to improve drainage. Most of the soil occurs near the Clinch River, the North Fork Clinch River, Stony Creek, Possum Creek, Longford Branch, and small streams in the vicinity of Hilton.

The surface layer, to a depth of 6 to 8 inches, is gray friable slightly plastic fine sandy loam or very fine sandy loam, containing small light-brown and rust-brown spots. Mottled gray, light-brown, and rust-brown friable to rather heavy somewhat plastic fine sandy clay, very fine sandy clay, or silty clay loam occurs below this layer and at about 24 inches passes into mottled gray, light-brown, and rust-brown silty clay loam material. The soil is very strongly acid to medium acid.

Use and management.—Practically all of Atkins fine sandy loam is used as pasture land, although a small total acreage is used for hay crops, the yields of which are fair. Under common management for pasture, about 5 acres of the soil furnish grazing for one head of cattle. Some of the native vegetation consists of ironweed, cinquefoil, white clover, bulrush, plantain, and oxeye daisy. Willow and alder grow in places.

BOLTON SERIES

The soils of the Bolton series are on valley uplands and are associated with soils of the Elliber and Frederick series. They are derived from weathered material of limestone with which sandstone is interbedded in layers of variable thickness. Fragments of the sandstone are on the surface and in the soil in some places. The small, scattered pieces of iron ore found on the surface probably have contributed coloring matter to the soil. The surface layers contain a moderate quantity of organic matter. The soils are porous and absorb moisture readily and are acid throughout the profile. They differ from Lodi soils in that their surface layers contain more organic matter, are less leached, and the soil profile is browner and contains black mineral concretions.

The surface layer, about 8 inches thick, is brown friable mellow porous soil. The subsoil, 22 to 40 inches thick, consists of yellowish-brown friable silty clay loam, containing many small black mineral particles. Partly decomposed chert fragments and weathered brown sandstone fragments are in the material in some places.
Bolton loam and its rolling, steep, eroded steep, and very steep phases are mapped.

**Bolton loam.**—This is a brown soil developed on cherty ridges in association with Frederick, Lodi, Elliber, and Clarksville soils. The relief is hilly, the slopes ranging from 17 to 35 percent. External drainage is medium to rapid and internal drainage medium.

This soil has formed from the residue of dissolved dolomitic limestone and sandy material from sandstone occurring with the limestone. In some places it is derived from the residue of dissolved high-calcic limestone and weathered sandstone.

The 8- to 10-inch surface layer consists of brown friable mellow loam, which is dark brown when wet. Some brown and dark-brown sandstones 4 to 6 inches in diameter and a few light-gray chert fragments 2 to 5 inches in diameter occur on the surface. The subsoil consists of yellowish-brown friable crumbly silty clay loam, containing small black mineral particles. At about 36 inches the subsoil passes into slightly reddish-brown friable crumbly silty clay or silty clay loam material, containing many small black mineral particles.

Included with this soil are small areas where the surface layer of the soil is dark-brown friable mellow loam 8 to 10 inches thick, and the subsoil is dark-red or maroon friable silty clay loam. This soil is called push land and was probably derived from the residue of dissolved high-calcic limestone and weathered sandstone. It is slightly more productive than the Bolton loam. Also included are small areas of Bolton loam from which about two-thirds of the surface layer has been removed by accelerated erosion. Shallow gullies have formed in places. These eroded areas are near Devils Race Path Branch and are better suited to pasture than to cultivated crops.

**Use and management.**—About 90 percent of Bolton loam has been cleared of forest and is in agricultural use. In the forested areas the trees are mainly red oak, chestnut oak, white oak, poplar, hickory, red maple, black locust, and dogwood. Some dead chestnut trees are among the other trees.

This soil is fairly easily worked and conserved. It apparently contains a fair quantity of organic matter, has good moisture-holding capacity, and is medium in productivity.

About 75 percent of the total area is used for crops and about 15 percent for pasture. Corn, wheat, hay, and tobacco are the principal crops. Where the common management is practiced, corn produces average yields of about 35 bushels an acre; wheat, 13 bushels; timothy and clover mixed, 1½ tons of hay; lespedeza, 1 ton of hay; and tobacco, 1,050 pounds. The pasture plants include bluegrass, white clover, and common lespedeza. Other small vegetation in pastures includes broomsedge, smilax, aster, yarrow, plantain, thistle, wild strawberry, dewberry, and blackberry. Larger vegetation consists mainly of sumac and sassafras. Under common management for pasture, about 4 acres of this soil afford pasture for one head of cattle.

Practices of management that help to improve and conserve this soil include strip cropping, contour tillage, and either long crop rotations in which the crops are rather heavily fertilized or short rotations in which the crops consist of small grain, clover, and grass, moderately fertilized.
Bolton loam, rolling phase.—This soil is associated with Lodi cherty loam and other soils on the cherty ridges. It has the same color, texture, and structure as the normal phase of the type, but differs mainly in having gentler slopes (8 to 17 percent as compared with 17 to 35 percent in the normal phase). Because of milder slopes, it is better suited to cultivation than the normal phase, and erosion is more easily controlled. External and internal drainage of the rolling phase are medium.

Included with this soil as mapped are small, slightly more productive areas of so-called push land in which the surface layer of the soil is dark-brown loam 8 to 10 inches thick, and the subsoil is dark-red or maroon friable silty clay loam.

Use and management.—Nearly all of Bolton loam, rolling phase, is cleared land in agricultural use. The soil has good workability and conservability and apparently contains a fair quantity of organic matter and is retentive of moisture. Its productivity is moderately high. Its main use is for crops consisting of corn, wheat, hay, and tobacco, and to a small extent oats. A small proportion of the soil is in pasture.

Under common management, corn gives average yields of about 38 bushels an acre; wheat, 15 bushels; oats, 23 bushels; timothy and clover mixed, 1½ tons of hay; lespedeza, 1½ tons of hay; and tobacco, 1,150 pounds. With common management for pasture, about 3½ acres of the soil produce grazing for one head of cattle.

Compared with the associated Lodi cherty loam, this rolling phase is less erosive, apparently contains more organic matter, and occupies moister positions, generally north and east exposures in the cherty ridges. The management requirements of the two soils, however, are practically the same.

Bolton loam, steep phase.—In color, texture, and structure this steep phase is similar to the normal phase of the type, but in some places the soil layers are thinner. This soil lies on slopes of 35 to 50 percent and has rapid external drainage and medium internal drainage. Because of the steep slopes, it is subject to rather severe erosion unless protected by a cover of grass or trees, and is much less desirable for cultivation than the normal phase. This steep phase is associated with areas of Lodi cherty loam, steep phase, and other soils on cherty ridges.

Use and management.—About 75 percent of the total area of Bolton loam, steep phase, has been cleared for agricultural use. In the uncleared areas the trees are the same kinds as those on Bolton loam.

On account of steepness, the soil is difficult to work. It apparently contains a moderate quantity of organic matter and has medium to moderately low productivity. Some small eroded areas are included with the soil as mapped.

The cleared areas of this steep phase are used mainly as pasture land. A small total acreage is used for corn and tobacco, which under common management give considerably lower yields than on the normal phase of the type.

In its present condition and under the management commonly practiced, this steep phase grows rather poor pasture in most places.
About 4½ acres are required to graze one head of cattle. To improve the pasture, it should be properly grazed and clipped, and the cattle fed on it during the dormant season. It should also be limed and fertilized with a complete fertilizer, or be manured well.

**Bolton loam, eroded steep phase.**—In profile and slope characteristics, this soil is similar to Bolton loam, steep phase, but includes areas in which the soil has lost about two-thirds of the surface layer through accelerated erosion. The thin surface layer that remains consists of brown rather heavy loam. Gullies have formed here and there in the soil. Small areas in which erosion is slight are included with this phase as mapped. This eroded steep phase is on slopes of 35 to 50 percent, but in a few areas they are considerably steeper. External drainage is very rapid and internal drainage medium. The soil is associated in places on cherty ridges with other Bolton soils and with Lodi and other soils.

**Use and management.**—A large part of the total area of Bolton loam, eroded steep phase, is used as pasture land and a large part is lying idle. A small total acreage is used for corn, the yields of which are low. The quality of the pasture is poor. Under common management for pasture, about 6 acres of this eroded steep phase furnish grazing for one head of cattle.

Owing to steep slopes and eroded surface layer, the soil is apparently better suited to forest than to pasture. With proper management, however, some of it could be made fairly good pasture land.

**Bolton loam, very steep phase.**—Comprising the steepest areas of Bolton loam, this soil has slopes of 50 percent or considerably more. It is similar to the normal phase of the type in color, texture, and structure but in some places the soil layers are not so thick. Some eroded areas are included with this soil as mapped and are shown on the soil map by symbols. This phase is associated in places with areas of other Bolton soils, and with areas of Lodi cherty loam, very steep phase, and other soils on cherty ridges.

**Use and management.**—Almost all of Bolton loam, very steep phase, is in forest, consisting of about the same kind of trees as those on Bolton loam. A small total acreage is used as pasture land, but the carrying capacity is low. Because of the steepness of this soil and the severe erosion to which it is subject when cleared of forest, the best use is for forest.

**BURGIN SERIES**

The soil of the Burgin series is on colluvial slopes in the valley uplands, where it is associated with soils of the Carbo series. It is derived from material washed mainly from Carbo soils and contains a fair quantity of organic matter, well incorporated in the surface layer. The reaction is acid.

The 5- to 10-inch surface layer consists of dark-gray, dark-brown, or dark grayish-brown heavy fine-textured soil. The subsoil is dark-gray heavy tough silty clay containing small brown spots. It is 18 to 22 inches thick and passes into dark-gray heavy plastic silty clay or clay, streaked or mottled brown and ocherous yellow. Burgin silty clay loam is mapped.
Burgin silty clay loam.—This is a dark-colored heavy-textured soil developed on foot slopes in the valley uplands from material washed mainly from Carbo soils. It occurs in scattered areas usually associated with these soils. The slopes occupied are nearly level to 5 percent, but in a few places they are somewhat stronger. External drainage is very slow to slow and internal drainage slow.

The 5- to 7-inch surface layer consists of dark-gray or dark grayish-brown heavy silty clay loam or silty clay, containing small brown spots. When dry the soil is medium gray or light gray and forms into hard angular aggregates about one-eighth of an inch in diameter. The subsoil is dark-gray, very dark-gray, or nearly black silty clay, which is tough and tight and when dry is hard. Brown spots and splotches appear in the subsoil in many places and small black mineral particles are present in most places. At a depth of about 24 inches the subsoil is underlain by dark-gray heavy plastic clay, mingled, mottled, or streaked with brown. This clay is slowly permeable.

Use and management.—Burgin silty clay loam has a moderate to high content of organic matter. It is fairly easily worked and very easily conserved. Its productivity is moderately high to high.

Nearly all of the soil is cleared land and is used for crops, mainly corn and hay. The soil seems to be best suited to corn, timothy, clover, alfalfa, and lespedeza, and to pasture.

Under common management, corn averages about 60 bushels an acre; timothy and clover mixed, 2 tons of hay; alfalfa, 3 tons; and lespedeza, 1½ tons. A small total acreage is used for pasture, and under common management about 2 acres are sufficient for one head of cattle.

CAMP SERIES

The soils of the Camp series are purplish brown to purplish red in color and have formed at the foot of slopes in valley uplands from material washed mainly from Teas-Litz and Teas-Dandridge soils. They occupy positions at the foot of the slopes and near intermittent drainageways similar to those occupied by soils of the Emory, Green-dale, and Leadvale series but have a different color than those soils and are derived from a different parent material. They are acid in reaction.

The 7- to 10-inch surface layer consists of purplish-brown friable fine-textured soil, containing a fair quantity of organic matter. The subsoil is light purplish-brown or purplish-red friable silty clay loam 18 to 26 inches thick. Beneath the subsoil the material is light purplish-brown friable silty clay loam, containing many purplish-brown and yellowish-brown small soft shale fragments and a few black mineral particles. In many places small purplish-brown and yellowish-brown shale fragments are also on the surface and in the surface layer and subsoil. Camp silt loam and its sloping phase are mapped.

Camp silt loam.—This is a purplish-colored soil on colluvial slopes and near intermittent streams in valley uplands. It has formed from material washed from Teas-Litz and Teas-Dandridge soils, and it is closely associated with areas of these soils. This soil is nearly level to about 5 percent in slope. It has very slow to slow external drainage and medium internal drainage.
The surface layer is 8 to 10 inches thick and consists of purplish-brown friable silt loam, light purplish brown when dry and dark purplish brown when wet. Thin purplish-brown and yellowish-brown shale particles are on the surface and in the surface layer in places, and a few brown sandstone fragments, 1 to 6 inches in diameter, are found on the surface. The subsoil is light purplish-brown or purplish-red friable silty clay loam, containing small particles of purple and yellowish-brown shale. At a depth of 28 to 34 inches the subsoil is underlain by light purplish-brown very friable clay loam or silty clay loam material, in which are many purple and yellowish-brown shale chips and some black mineral particles.

Use and management.—Practically all of Camp silt loam is cleared land in agricultural use. It is easily tilled and conserved. It is apparently low in organic matter, has good moisture-holding capacity, and its productivity is medium to moderately high. A large part of the total area is used for crops and some is used for pasture. Corn, wheat, hay, and tobacco are the principal crops.

Under common management, corn gives average yields of about 40 bushels an acre; wheat, about 13 bushels; timothy and clover mixed, about 1 1/2 tons of hay; lespedeza, about 1 ton of hay; and tobacco, about 1,300 pounds. With management commonly practiced for pasture, about 3 acres of the soil furnish grazing for one head of cattle.

Camp silt loam, sloping phase.—Similar to the normal phase of the type in color, texture, and structure, this phase differs in having slightly thinner soil layers, in having more shale fragments on the surface and in the profile, and in occupying somewhat stronger slopes (5 to 15 percent). It is associated with areas of the normal phase.

Use and management.—Practically all of Camp silt loam, sloping phase, is cleared land used largely for crops. It is easy to work and to conserve, and its productivity is medium. Corn, wheat, hay, and tobacco are the principal crops. A small part of the soil is used for pasture. Under common management, corn averages about 37 bushels an acre; wheat, 12 bushels; timothy and clover, 1 1/2 tons of hay; lespedeza, 1 ton of hay; and tobacco, 1,200 pounds. Under common management for pasture, about 3 acres of the soil afford pasture for one head of cattle.

**CARBO SERIES**

The soils of the Carbo series have formed on valley uplands in association with soils of the Westmoreland, Teas, and Pisgah series. They have developed from residual material of argillaceous limestone, platy limestone, or limestone containing thin layers of shale. The surface layer generally is low in content of organic matter. The soils are acid in reaction.

The surface layer is light brown or yellowish brown, fine-textured, and 5 or 6 inches thick. The upper part of the subsoil, 7 to 13 inches thick, is yellowish-brown, brownish-yellow, or light-brown fairly plastic heavy silty clay loam or silty clay, and the lower part, about 10 inches thick, shows very little change in color but is heavy plastic silty clay. Beneath the subsoil there is mixed light yellowish-brown, ochrous-yellow, and gray friable rather plastic silty clay loam parent material, containing greenish-yellow decomposed shale in many places. The limestone bedrock generally lies at a depth of 32 inches.
or more, but in some places it is at less depth. In many areas the bedrock outcrops and makes the land stony.

Soils of this series mapped are Carbo silty clay loam and its rolling phase; Carbo stony silty clay loam and its rolling phase; Carbo silt loam and its steep phase; and Carbo very fine sandy loam and its steep phase.

**Carbo silty clay loam.**—This is a light-colored soil on valley uplands, where it has formed from residual material of weathered limestone and shale mixed, platy limestone, or argillaceous limestone. This soil has hilly relief, with slopes ranging from 15 to 30 percent. External drainage is rapid and internal drainage medium to fairly slow. The areas of this silty clay loam are rather widely scattered and are to be found in the northeastern, eastern, southeastern, southern, southwestern, western, and central parts of the county.

The surface layer consists of light-brown or slightly yellowish-brown friable silty clay loam or heavy silt loam. When wet the soil is brown. Many of the small eroded spots in the soil have a reddish cast. In wooded areas and in pastures the first inch of the surface layer is light grayish-brown or grayish-brown heavy silt loam, containing a small quantity of organic matter derived from decayed vegetation. The subsoil begins as yellowish-brown, light-brown, or brownish-yellow moderately friable plastic clay and at a depth of about 12 inches changes to light-brown or yellowish-brown heavy plastic silty clay. Small black mineral particles are throughout the subsoil. Black mineral film appears in the lower part of the subsoil and in some places dark reddish-brown mineral material coats the breakage planes. At a depth of 24 to 26 inches, the subsoil gives way to mingled brown, dark reddish-brown, and ochorous-yellow fairly friable plastic silty clay material. This material contains greenish-yellow decomposed shale, a few black mineral particles, and some black mineral film. Limestone bedrock lies at a depth of about 35 inches or even less and outcrops appear in places.

**Use and management.**—Practically all of Carbo silty clay loam has been cleared of forest and nearly all the cleared land is used for cultivation. Owing to strong slopes and rather heavy texture of the surface layer, tillage operations on this soil are fairly difficult. The soil is not easily conserved, and erosion is active in some places. The organic-matter content of the soil is low. The productivity is medium.

Corn, wheat, and hay are the main crops. Tobacco is grown to a small extent. A small total acreage is used for pasture.

Under common management, corn produces average yields of about 38 bushels an acre; wheat, 12 bushels; timothy and clover mixed, 1½ tons of hay; lespedeza, 1½ tons of hay; and tobacco, 1,000 pounds. With common management for pasture, about 2½ acres of the soil afford pasture for one head of cattle.

The control of erosion is an important management problem on this soil. In order to control erosion, strip cropping should be practiced, longer crop rotations than commonly used should be followed; and legumes should be grown more often in the rotations. If short crop rotations are used, they should consist mainly of small grain and grass. As the soil has rather heavy texture, its tilth would be improved by supplying the proper amount of organic matter.
Carbo silty clay loam, rolling phase.—This phase is similar to Carbo silty clay loam in color, texture, and structure, differing mainly in having slightly thicker profile layers and gentler slopes. Its slopes range from 8 to 15 percent, whereas those of the normal phase of that type range from 15 to 30 percent. It has medium external drainage and medium to fairly slow internal drainage. Small eroded areas have formed in places. Areas of this phase are rather widely scattered and are in the same parts of the county as the normal phase.

Use and management.—Practically all of Carbo silty clay loam, rolling phase, has been cleared of forest and is in agricultural use. The soil is fairly easy to till and to conserve and has moderately high productivity.

The crops grown are chiefly corn, wheat, and hay. Tobacco is grown on some areas. A small total acreage is in pasture. Under common management, crops and pasture on this soil give slightly higher average yields than on the normal phase of the type.

This rolling phase seems to be best suited to corn, tobacco, small grains, and hay crops. In the common management of this soil a 4-year crop rotation is used. This rotation includes corn or tobacco the first year, wheat or other small grain the second, clover the third, and grass the fourth. Shorter or longer rotations, including the same crops as in this rotation, are used in some places. The corn, tobacco, and small grain generally are fertilized, and in some rotations clover is top-dressed with phosphatic fertilizer. The common fertilization for corn and wheat consists of the equivalent of 150 to 250 pounds an acre of 20-percent superphosphate, or of 4-12-4 mixture. For tobacco it consists of 400 to 800 pounds an acre of 3-8-3, 3-10-6, or 4-12-4 mixture, or 200 to 400 pounds an acre of 20-percent superphosphate and 10 to 20 wagonloads of manure. The fertilizer for corn and tobacco generally is placed in the row and that for wheat is either drilled in or is broadcast. Lime is not used in most fields; and in only a few fields is manure or other organic matter applied to eroded spots. Contour tillage is not generally practiced.

Contour tillage; the use of short crop rotations, in which legumes are turned under; application of larger quantities of fertilizer together with 1 ton an acre of ground limestone; and mulching of eroded spots with manure are necessary to produce the optimum growing conditions on this phase.

Carbo stony silty clay loam.—Areas in which there are many small limestone outcrops are included in this soil, which is hilly and steep, with slopes ranging from 15 to 60 percent. External drainage is rapid to very rapid and internal drainage medium to fairly slow. The soil is distributed mostly in the eastern and southern parts of the county, but some is in the northeastern, southeastern, southwestern, western, and central parts.

The surface layer of the soil consists of light-brown or yellowish-brown silty clay loam or heavy silt loam about 6 inches thick. The subsoil is yellowish-brown or brownish-yellow plastic silty clay to a depth of about 12 inches, where it changes to yellowish-brown heavy plastic silty clay. At a depth of about 24 inches the subsoil passes into mingled brown, dark reddish-brown, and ochreous-yellow friable somewhat plastic silty clay material, containing soft decomposed greenish-yellow shale particles and black mineral films. The bedrock
underlies the soil at a depth of 30 inches or more, but in some places the soil is shallower, and the bedrock underlies it at a depth of 6 to 30 inches.

The limestone outcrops in the soil occupy 15 to 40 percent of the surface. These outcrops are 2 to 5 feet across and protrude above the surface from a few inches to about 36. Some loose limestone fragments are on the surface in places. Considerable erosion has taken place near the outcrops in places.

Use and management.—A large part of Carbo stony silty clay loam has been cleared of forest, and the cleared soil is difficult to conserve. The soil has medium to low productivity. It is generally too stony for feasible cultivation, but here and there an acre or so practically free of outcrops can be cultivated.

Nearly all the cleared soil is used as pasture land, but some less stony areas are used as cropland, mainly for corn. Alfalfa is grown in a few places. A fairly large apple orchard is on this soil about 1½ miles southeast of Hilton.

Under common pasture management, consisting mainly of close grazing, about 3½ acres of this soil afford grazing for one head of cattle.

The main practices for improving the pasture to an optimum condition include proper grazing, proper fertilization with phosphatic fertilizer, and feeding cattle on the land during the dormant pasture season (pl. 7, A). Under proper management this soil supports a good type of pasture vegetation consisting of bluegrass, white clover, and crabgrass.

Carbo stony silty clay loam, rolling phase.—This rolling phase includes the smoother areas of the Carbo stony silty clay loam type. It is similar to the normal phase of the type in color, texture, and structure and in limestone outcrops present, but differs mainly in having gentler slopes of 3 to 15 percent. This rolling phase is in the same parts of the county as the normal phase and most of it is cleared land. External drainage is slow to medium and internal drainage medium to fairly slow. Although some erosion is evident in places near the limestone outcrops, the soil is easy to conserve. It is moderately well supplied with organic matter and lime and its productivity is medium to moderately high.

Use and management.—Although a few small areas of Carbo stony silty clay loam, rolling phase, free or practically free of limestone outcrops, are suitable for cultivation, most of this rolling phase is too stony to cultivate. A large part is used as pasture land, and a small part mainly for corn and alfalfa. Under common management, pasture on about 3 acres of the soil sustains one head of cattle; corn averages about 20 bushels an acre; and alfalfa, about 2 tons of hay.

The common management for pasture consists mainly of close grazing, although a few areas have been treated with phosphatic fertilizer. This rolling phase is well suited to pasture. Where pastures are properly treated with phosphatic fertilizer, desirable pasture plants increase and generally form a heavy sward, in which close grazing keeps down undesirable pasture plants.

Proper grazing, fertilization with proper amounts of phosphatic fertilizer, and feeding cattle on the land during the dormant pasture season seem to be all that is needed to keep pasture in the optimum condition for grazing.
Carbo silt loam.—The relief of this soil is dominantly hilly, the slope ranging from 15 to 30 percent. In a few areas it is rolling, with slopes from 8 to 15 percent. External drainage is medium to rapid and internal drainage medium to fairly slow. Areas of this soil are widely scattered and are located in the northern, southeastern, southern, western, and northwestern parts of the county.

The surface layer is about 6 inches thick and consists of light yellowish-brown friable silt loam, which when dry is light grayish brown and when wet is brown. In wooded places and in pastures the surface layer to a depth of about an inch is darker in color because of an accumulation of a small quantity of organic matter from decayed vegetation. The subsoil consists of friable somewhat plastic silty clay, becoming heavier and more plastic at an average depth of about 15 inches. The material of the subsoil easily breaks into hard lumps 1 to 2 inches in diameter. Black mineral specks are in the material in places, and black mineral film is on some breakage planes. At a depth of 24 to 28 inches the subsoil passes into coarsely mingled yellowish-brown, dark-red, and light-gray friable plastic silty clay material, containing soft yellowish-brown shale particles, small black mineral particles, and black mineral film. At 36 to 48 inches the soil is underlain by platy or shaly limestone from weathered material from which the soil is derived.

Use and management.—Nearly all of Carbo silt loam is cleared land in agricultural use. This soil is fairly easy to work but is rather difficult to conserve. It is medium to moderately high in productivity.

A large part is used for crops, consisting of corn, wheat, and hay and to a much less extent of rye, oats, barley, and tobacco. A small part is used for pasture.

Under common management, corn averages about 37 bushels an acre; wheat, 12 bushels; rye, 12; oats, 18; barley, 27; timothy and clover mixed, 1½ tons of hay; lespedeza, 1½ tons of hay; and tobacco, 1,000 pounds. Under common management pasture on about 2½ acres produce grazing for one head of cattle.

This soil is subject to rather severe erosion, and the control of erosion is important. Management practices for this purpose include strip cropping, more frequent growing of legumes, and the use either of longer crop rotations than commonly used or of shorter rotations of small grain and grass.

Carbo silt loam, steep phase.—This phase includes the steepest areas of Carbo silt loam, with slopes ranging from 30 to 60 percent. Although the color, texture, and structure are similar to those of the normal phase of the type, this steep phase has thinner profile layers in many places. Areas of the soil are in the northern, southeastern, southern, and western parts of the county.

Use and management.—Most of Carbo silt loam, steep phase, has been cleared of forest for agricultural use. In the uncleared areas the trees consist mainly of black and white oaks, red maple, beech, tuliptree, hickory, and black locust.

Much of the cleared soil is used as pasture land, and the rest as cropland, mainly for corn. Under common management for pasture about 4 acres afford pasture for one head of cattle. The yields of corn are somewhat lower than those obtained on the normal phase.

Because of steep slopes, the soil is difficult to work and to conserve. It is poorly suited to cultivated crops, and its best use is for pasture.
Carbo very fine sandy loam.—The relief in most areas of this soil is hilly, but in a few areas it is rolling. In the hilly relief the slopes range from 15 to 30 percent, and in the rolling from 8 to 15 percent. External drainage is medium to rapid and internal drainage is medium to fairly slow. The soil is confined in development mainly to the southeastern and southern parts of the county.

The surface layer consists of light-brown or light yellowish-brown friable very fine sandy loam about 6 inches thick. When dry it is light grayish-brown and when wet, brown. In wooded areas and in pastures the first inch of the surface layer is darker in color because of the presence of a small quantity of decomposed vegetation. The subsoil consists of yellowish-brown or brownish-yellow fairly plastic very fine sandy clay or silty clay loam, being slightly heavier and more plastic at a depth of 15 to 18 inches. At 24 to 28 inches the subsoil is underlain by mingled or mottled yellowish-brown, dark reddish-brown, and light-gray friable somewhat plastic very fine sandy clay or silty clay loam material.

Use and management.—Nearly all of Carbo very fine sandy loam has been cleared of forest and is in agricultural use. Tillage operations are fairly easy. The soil is rather difficult to conserve, and small eroded areas have formed here and there. The productivity is medium to moderately low.

A large part of this soil is used for crops, mainly corn, wheat, and hay. Tobacco is grown to some extent. A small total acreage is used as pasture land.

Corn, under common management, produces average yields of about 32 bushels an acre; wheat, 18 bushels; timothy and clover mixed, 1 ton of hay; lespedeza, 1 ton of hay; and tobacco, 1,050 pounds. With common management, pasture on about 3½ acres is sufficient for one head of cattle.

Carbo very fine sandy loam, steep phase.—Including the steepest areas of Carbo very fine sandy loam, the slopes of this phase range from 30 to 60 percent. It is similar to the normal phase of the type in color, texture, and structure, but its profile layers are not so thick in many places. The soil is subject to rather severe erosion unless protected by a cover of grass or forest. It is too steep in most places for feasible cultivation. Most of this soil is in the southeastern and southern parts of the county.

Use and management.—A large part of Carbo very fine sandy loam, steep phase, has been cleared of forest, and the cleared soil is used mainly as pasture land. Under common management, about 4¾ acres of the pasture land afford grazing for one head of cattle. A few small areas are planted to corn, and the yields are fair.

CHILHOWIE SERIES

Ranging in depth to bedrock from a few inches to about 20 inches, the soils of the Chilhowie series are comparatively shallow. They are associated on well-drained valley uplands with soils of the Carbo series. These soils are medium acid to mildly alkaline in reaction, depending on the depth to bedrock.

The surface layer is grayish brown to dark gray, heavy textured, and 3 to 6 inches thick. Underlying this layer is yellowish-brown
or mingled grayish-brown and brown tough rather plastic silty clay or clay material, containing fragments of limestone. The parent rock, consisting of limestone containing clayey and shaly material, is at a depth of 10 to 24 inches, but in some places is immediately below the surface layer. The severely eroded and severely eroded steep phases of Chilhowie stony clay are mapped.

**Chilhowie stony clay, severely eroded phase.**—This severely eroded phase is hilly, having slopes of 15 to 30 percent. In a few places it is rolling with slopes ranging from 8 to 15 percent. Areas of the soil are east and southeast of New Hope Church and south of McConnell Mill.

Because of accelerated erosion, this soil is very shallow. It is mainly soil material rather than true soil. To a depth of 2 or 3 inches it consists of grayish-brown or mingled gray, rust-brown, and brown fairly heavy silty clay. Beneath this thin layer is mingled grayish-brown and tough moderately plastic silty clay or clay material, intermixed with limestone fragments, ranging from one-half of an inch to 2 inches across and comprising about 50 percent of the mass. At a depth of about 8 inches, this material is underlain by broken partly weathered limestone, which in turn is underlain at a depth of about 15 feet by solid limestone bedrock. Many flat limestone fragments, 4 to 8 inches across, are strewn over the surface. In a few small areas here and there, the soil has been affected very little by erosion. The surface layer of the soil in these areas consists of dark grayish-brown or dark-gray silty clay or moderately heavy silty clay loam, 5 or 6 inches thick, and the subsoil consists of yellowish-brown tough, plastic silty clay to a depth of about 20 inches.

**Use and management.**—Practically all of Chilhowie stony clay, severely eroded phase, is cleared land, most of which is used for pasture. A small total acreage is used for corn and hay crops. Under common management, corn averages about 15 bushels an acre; timothy and clover mixed, about ½ ton of hay; and alfalfa about 2 tons of hay. Under common management practices 5 or 6 acres afford grazing for one head of cattle.

Trees on the soil are mainly redcedar, which are generally small. There are also a few black walnut, black locust, and tuliptrees. Smaller native vegetation includes hawthorn, wild rose, thistle, broomsedge, pennyroyal, milkweed, oxeye daisy, wild carrot, and ironweed.

This severely eroded phase is better suited to pasture than to cultivated crops. Pasture partly shaded with black locust and black walnut trees is probably better than open pasture. Phosphatic fertilizer is needed to improve pasture on this soil, but in most places lime is not needed.

The soil has low moisture-holding capacity, and practices that will help conserve moisture are most important in the management of the soil for pasture. Mulching with both manure and straw wherever possible would improve the moisture conditions.

**Chilhowie stony clay, severely eroded steep phase.**—This soil is similar to Chilhowie stony clay loam, severely eroded phase, in physical characteristics but differs from that soil in occupying much steeper slopes and in having a greater number of loose limestone fragments
on the surface. The slopes range from 30 to 60 percent. This severely eroded steep phase is associated with areas of Chilhowie stony clay, severely eroded phase.

_Use and management._—Most of Chilhowie stony clay, severely eroded steep phase, is used as pasture land. Under the management commonly practiced for pasture, about 6 acres of the soil afford grazing for one head of cattle. A few small areas are used for alfalfa, and under common management, alfalfa produces about 1½ tons of hay per acre. Since the steep slopes and severe erosion make the soil very poorly suited to cultivation, its best uses are for pasture and forest (pl. 6, C).

**CLARKSVILLE SERIES**

The soils of the Clarksville series are developed on valley uplands from residual material of limestone containing much chert and in some areas sandstone in addition to the chert. When the limestone breaks down through weathering, the many small chert fragments that remain and become a part of the soil make the soil cherty. The sandstone contributes sandy material to the soil in many areas. Nearly everywhere small chert fragments, and in some places small sandstone fragments, are strewn over the surface.

The upper part of the surface layer is light-gray or light yellowish-gray friable silt loam, or loam, about 7 inches thick. The lower part is slightly brownish-yellow or light yellowish-brown friable rather heavy silt loam, loam, or fine sandy loam 5 to 11 inches thick. The subsoil is light brownish-yellow or light yellowish-brown friable silty clay loam 15 to 24 inches thick. This material is hard when dry. Below the subsoil is mottled or mingled brown, rust-brown, ocherous-yellow, and light-gray friable silty clay loam. In some places dark-red spots or mottings are in this material.

The Clarksville soils are considerably leached and low in organic matter and, when dry, are very light gray or almost white in the surface layer. They are relatively low in natural fertility and are acid throughout the profile. The following soils are mapped in the Clarksville series: Clarksville cherty silt loam and its steep phase; and the hilly and steep phases of Clarksville cherty loam.

**Clarksville cherty silt loam._—This is a light-colored porous soil on cherty ridges, where it is associated with Frederick, Lodi, Bolton, and Elliber soils. It has formed from weathered material of dolomitic limestone containing much chert. The relief is dominantly hilly, the slopes ranging from 15 to 26 percent. In a few areas the relief is rolling, with slopes from 8 to 15 percent. External drainage is medium to rapid and internal drainage is medium.

The surface layer consists of light-gray or light grayish-yellow friable silt loam to a depth of about 7 inches, and of a slightly brownish-yellow or light yellowish-brown friable rather heavy-textured silt loam to a depth of 12 to 15 inches. When dry the surface layer is very light gray or almost white. In wooded areas the first inch or two of the surface layer consists of grayish-brown light-textured silt loam, the darker color being due to organic matter derived from decayed leaves and twigs. The subsoil consists of light yellowish-brown or light brownish-yellow friable silty clay loam, which is hard when dry. At 32 to 35 inches the subsoil passes into
mingled brown, rust-brown, ocherous-yellow, and light-gray friable silty clay loam material. Light-gray and brownish-yellow chert fragments, 1/4 inch to 3 inches in diameter, are scattered over the surface and mixed through the profile. These fragments are so numerous that the soil is rendered cherty by them.

Use and management.—A large part of Clarksville cherty silt loam has been cleared of forest and is in agricultural use. In the uncleared areas the trees are mainly white, scarlet, red, and black oaks, hickory, red maple, black locust, and dogwood.

Tillage operations on this cherty soil and the conservation of soil material and plant nutrients are rather difficult. The soil is inherently poor, low in organic matter, and considerably leached. Its productivity is moderately low.

Most of the cleared soil is used for crops, consisting mainly of corn, wheat, and hay. A small part is used as pasture land. Under common management, corn gives average yields of about 25 bushels an acre; wheat, 12 bushels; timothy and clover mixed, 1 ton of hay; and lespedeza, 1 ton of hay. Under common management for pasture, about 4 1/2 acres supply grazing for one head of cattle.

Clarksville cherty silt loam, steep phase.—This soil includes the steeper areas of Clarksville cherty silt loam, with slopes ranging from 26 to 50 percent. It is similar to the normal phase of the type in profile characteristics, except that the layers are not everywhere so thick and that a greater quantity of chert fragments are on the surface and in the profile. This steep phase is associated in places with the normal phase of the type and with other soils on cherty ridges.

Use and management.—Clarksville cherty silt loam, steep phase, is poorly suited to cultivation and is subject to rather severe erosion unless protected by a cover of grass or trees. It is porous and has undergone much leaching. Most of it has been cleared of forest and is used as pasture land. Under common management for pasture, about 5 acres of this soil are required to furnish grazing for one head of cattle. A few areas are planted to corn, and the yields of corn are somewhat lower than those obtained on the normal phase.

Clarksville cherty loam, hilly phase.—This is a light grayish-yellow soil on well-drained valley uplands, where it has formed from weathered material of dolomitic limestone containing much chert and thin layers of sandstone. The relief is hilly (12- to 24-percent slopes), but in a few small areas it is rolling (6- to 12-percent slopes). External drainage is medium to rapid and the internal drainage medium. There are some small eroded areas, and gullies have formed in a few places. This cherty soil occupies areas mainly north of Thompson Ford and east of Wells Chapel. It is associated with areas of Lodi cherty loam, hilly phase, and as mapped includes small areas of that soil.

The surface layer consists of light-gray or grayish-yellow friable loam to a depth of about 7 inches, and of grayish-yellow friable loam or heavy loam to a depth of about 15 inches. In forested areas to a depth of about 1 inch the soil is gray or dark-gray friable loam or fine sandy loam, containing a small quantity of organic matter derived from decayed leaves and twigs. The subsoil is yellow or slightly brownish-yellow friable fine sandy clay or silty clay loam, passing at a depth of about 32 inches into mingled brown, rust-brown, ocherous-yellow,
and light-gray friable fine sandy clay or silty clay loam material. Many light-gray chert fragments and light-brown sandstone fragments, \( \frac{3}{4} \) to 4 inches in diameter, are scattered over the surface and mixed through the profile. The soil is made porous by these fragments, and considerable leaching has taken place.

*Use and management.*—About 65 percent of Clarksville cherty loam, hilly phase, has been cleared of forest, and in the uncleared areas the growth consists chiefly of white and red oaks, tuliptree, hickory, red maple, and dogwood. Dead chestnut trees are among the other trees.

The cleared areas are used for crops, mainly corn, wheat, and tobacco, and for pasture. With management commonly practiced, corn yields average about 12 bushels an acre; wheat, 7 bushels; and tobacco, 1,000 pounds. Under common management for pasture, 5 to 6 acres afford grazing for one head of cattle.

**Clarksville cherty loam, steep phase.*—This soil has much steeper slopes (24 to 50 percent) than those of Clarksville cherty loam, hilly phase. In color, texture, and structure it is similar to the hilly phase, but it contains more chert and sandstone fragments and is more leached. This steep phase is associated with areas of Clarksville cherty loam, hilly phase, and with areas of other soils on cherty ridges.

*Use and management.*—A large part of Clarksville cherty loam, steep phase, is forested with the same kinds of trees as grown on the hilly phase. A small total acreage is used for corn and a small total acreage for pasture land. The yields of corn are low. Under common management for pasture, it takes 6 to 7 acres of the soil to supply grazing for one head of cattle.

**DANDRIDGE SERIES**

The soils of the Dandridge series are on valley uplands, mainly in hilly, knobby, and broken areas. They are associated with soils of the Teas and Carbo series, and their depth is about the same as that of Teas and Westmoreland soils. Although they resemble Westmoreland soils, they differ from them in that they are derived from weathered calcareous shale instead of weathered shale and limestone mixed. These soils are variable in reaction from place to place but usually are slightly acid or neutral.

The surface layer consists of grayish-brown, brown, or light-brown fine-textured friable soil 3 to 6 inches thick. The subsoil is light-brown, brownish-yellow, or yellowish-brown friable silty clay loam 5 to 15 inches thick, but in many places very little or no subsoil is present. In many places soft decomposed shale particles are mixed through the subsoil. Beneath the subsoil there is grayish-yellow and light brownish-yellow, or brown, dark reddish-brown, and gray friable crumbly silty clay mixed with greenish-yellow, light-green, and reddish-brown soft decomposed shale particles, comprising 40 to 60 percent of the mixture. At a depth of 24 to 40 inches this material gives way to dark-green and light-green decomposing shale with a small accumulation of earthy material in the crevices.

The eroded, eroded hilly, and very steep phases of Dandridge silt loam are mapped. In addition, Dandridge soils are mapped in the Teas-Dandridge complex.
Dandridge silt loam, eroded phase.—This soil has formed from weathered material of calcareous shale. In some places grayish-green hard calcareous sandstone and grayish-blue hard impure limestone are interstratified with the calcareous shale. The soil occupies steep relief, with slopes ranging from 30 to 60 percent. Tillage operations and erosion control are difficult, and the soil is poorly suited to cultivation.

In most places this soil has been eroded to such an extent that about two-thirds of the surface layer is gone. In forested areas, where erosion is at a minimum, the surface layer consists of grayish-brown, brown, or light-brown friable silt loam, 5 or 6 inches thick. A small quantity of organic matter from decayed leaves and twigs is mixed with the first inch or two of this layer. Nearly all the soil has been cleared of forest and in most places has been eroded. In cultivated areas some subsoil material has been mixed with the thin surface layer, and the plowed layer consists of light-brown or yellowish-brown heavy silt loam or light silty clay loam. In some places all the surface layer is gone and the subsoil is exposed. Many small fragments of thin light-green and brown shale and light-brown sandstone are scattered over the surface in places.

The subsoil in both uneroded and eroded areas consists of brownish-yellow or yellowish-brown friable silty clay loam. At a depth of 14 to 20 inches it grades into mingled brownish-yellow, brown, and light-gray silty clay loam material, containing yellowish-brown soft decomposed shale fragments. In some places the subsoil is absent and the surface layer passes into soft decomposed shale. Areas of this soil are in the northern, southern, and western parts of the county.

Use and management.—Of the cleared areas of Dandridge silt loam, eroded phase, a large part is used for pasture and the rest for crops, principally corn. Under management commonly practiced, about 5 acres afford pasture for one head of cattle, and corn averages about 17 bushels an acre.

In the past a much larger total acreage was planted to corn than at the present time. The corn was grown year after year without the use of cover crops, and this practice probably brought about the erosion of much of the soil.

In some sections this soil is the only grazing land. It grows better pasture and is subject to less erosion where protected by thin stands of black locust and black walnut trees than where not so protected. Some areas once under cultivation are now in permanent pasture, but the thin stand is not sufficient to hold the soil.

Dandridge silt loam, eroded hilly phase.—Similar in color, texture, structure, and degree of erosion to Dandridge silt loam, eroded phase, this hilly phase differs in having much gentler slopes (15 to 30 percent). It is distributed in the northern, southern, and western parts of the county, where it is associated with areas of the eroded phase.

Use and management.—Practically all of Dandridge silt loam, eroded hilly phase, is used as cropland and pasture land, with about equal total acreages for each. Corn is the principal crop. Under common management practiced the yields of corn and the carrying capacity of pastures are about the same as those for Dandridge silt loam,
eroded phase. The soil is difficult to till and to conserve and is moderately low in productivity. The best use is for pasture.

**Dandridge silt loam, very steep phase.**—On the slopes occupied by this very steep phase, which are 60 percent or considerably more, only a shallow soil has formed. In the areas mapped on Powell Mountain the soil is somewhat deeper than elsewhere and contains an appreciable quantity of sandy material. It is underlain by a rock formation that contains less shale and more sandstone than the rock formation giving rise to this soil elsewhere in the county. The sandstone has contributed sandy material to the soil. Areas of this soil are in the northern, southern, and western parts of the county.

The surface layer of the soil is brown or grayish-brown friable silt loam, 3 to 6 inches thick. In some places this layer is underlain by light-brown or yellowish-brown friable silty clay loam material to a depth of 7 or 8 inches, where it gives way to soft yellowish-brown or greenish-yellow weathered shale. In other places it is underlain directly by yellowish-brown or greenish-yellow partly decomposed shale. Some loose stones are on the surface, and rock outcrops occur here and there.

**Use and management.**—About 95 percent of Dandridge silt loam, very steep phase, is under a cover of forest; the rest, which is cleared land, is used for permanent pasture. The forest cover includes mainly beech, red maple, tuliptree, hickory, ironwood, black and Spanish oaks, and black locust. When cleared of forest, this very steep phase is subject to severe erosion. In the grazing areas the pasture is sparse. Because of steepness and the hazards of erosion in cleared areas, the best use for this very steep phase is for forest.

**DEKALB SERIES**

The soil of the Dekalb series is on some of the highest elevations on steep slopes of knobs and ridges of the Cumberland Plateau. It is derived from weathered material of a rock formation composed of sandstone and some calcareous shale. Much organic matter from the decay of leaves, twigs, and grass has accumulated in the upper layer, giving it a dark color. Some sandstone fragments are on the surface and in the upper profile, but they are most numerous in the lower part. The soil is strongly to very strongly acid.

The profile of the Dekalb soil has a 6-inch dark-brown or dark grayish-brown friable surface layer underlain by an 18-inch subsoil layer of slightly yellowish-brown or light-brown light-textured very friable fine sandy clay or slightly plastic silty clay loam. Beneath the subsoil the material consists of light-brown or yellowish-brown very friable fine sandy clay or heavy loam mixed with sandstone fragments. Only one type, Dekalb loam, is mapped.

**Dekalb loam.**—This soil has formed from residual products of weathered sandstone and calcareous shale. It is on slopes of 30 to 60 percent. External drainage is rapid to very rapid and internal drainage medium. Areas of the soil are near the Wise County line at the head of Straight Fork and near Camp Rock.

The 5- or 6-inch surface layer is dark-brown or dark grayish-brown friable mellow silt loam, very dark brown when wet and dark gray
when dry. The soil contains a fairly large quantity of organic matter derived from decayed leaves, grass, and twigs, which gives it a dark color. The subsoil consists of slightly yellowish-brown or light-brown friable crumbly fine sandy clay or friable somewhat plastic silty clay loam. Some partly decomposed greenish-yellow sandstone fragments, ¼ inch to 6 inches in diameter, are in the subsoil. At a depth of about 24 inches the subsoil is underlain by yellowish-brown or finely mingled light-brown, yellowish-brown, and light-gray friable crumbly fine sandy clay material, intermixed with brown and greenish-yellow sandstone fragments, 4 to 6 inches in diameter. Brown sandstone fragments, 4 to 6 inches in diameter, appear on the surface in places. The sandstone and shale bedrock generally lies at a depth of 35 to 40 inches.

Use and management.—A few areas of Dekalb loam are used as pasture land, and ordinarily it takes about 6 acres to graze one head of cattle. Pasture plants include bluegrass, orchard grass, and white clover. Other vegetation in pastures is broomsedge, yarrow, hawkweed, cinquefoil, hawthorn, sumac, and bramble.

The trees in the forested areas are mainly Spanish and Northern red oaks, red maple, tuliptree, black locust, hickory, birch, dogwood, and redbud. Some dead chestnut trees are in the stand.

DUNMORE SERIES

The soils of the Dunmore series are developed on valley uplands from weathered limestone residuum, consisting of silt and clay mainly and some chert and soft shalelike material. They are associated with soils of the Hagerstown, Frederick, and Lodi series. In general they have a comparatively shallow surface layer. They are rather low in content of organic matter and are acid in reaction.

The uneroded surface layer is 3 to 7 inches thick and consists of light-brown friable fine-textured soil. The 24- to 28-inch subsoil is yellowish-brown or faintly reddish-brown somewhat tough slightly plastic smooth silty clay, taking a high polish on a cut surface. Beneath the subsoil is mottled or streaked ocherous-yellow and brownish-red friable silty clay loam or silty clay, underlain at a depth of 48 to 120 inches or more by limestone bedrock.

Only the eroded hilly and eroded steep phases of Dunmore silty clay loam are mapped. In these eroded soils small virtually uneroded areas remain here and there.

Dunmore silty clay loam, eroded hilly phase.—A few limestone outcrops occur here and there on this soil, which has formed from the residue of dissolved limestone. The slopes range from 15 to 30 percent. External drainage is rapid and internal drainage medium. The productivity is medium to moderately high. Areas are in the southeastern part of the county near the Tennessee border.

In uneroded areas or only slightly eroded areas the surface layer is about 6 inches thick and consists of brown or grayish-brown friable silt loam, which when dry is light brown or light grayish brown. Throughout most of this soil accelerated erosion has removed 25 to 75 percent of the surface layer. In cultivated areas subsoil material is mixed with the remaining surface layer, and the plowed layer is reddish-brown or reddish-yellow silty clay loam. The subsoil consists of brownish-yellow, yellowish-brown, brownish-red, or yellowish-
red heavy rather plastic silty clay or clay to a depth of about 25 inches, where it passes into mingled reddish-brown, ochreous-yellow, and gray plastic clay soil material containing small particles of brownish-yellow partly decomposed shale and small gray fragments of limestone.

Use and management.—Nearly all of Dunmore silty clay loam, eroded hilly phase, is in agricultural use, mainly as cropland and pasture land. Corn, wheat, and hay are the principal crops. Under common management corn averages about 30 bushels an acre; wheat, 12 bushels; timothy and clover mixed, 1 1/2 tons of hay; and lespedeza, 1 ton of hay. Under the management commonly practiced for pasture, about 3 1/2 acres of the soil supply grazing for one head of cattle.

Tillage operations and the conservation of the soil are somewhat difficult. The control of erosion is an important problem in the management of this phase.

Dunmore silty clay loam, eroded steep phase.—This phase is similar to Dunmore silty clay loam, eroded hilly phase, in color, texture, structure, and degree of erosion, but differs in having stronger slopes of 30 to 60 percent. It is associated with areas of Dunmore silty clay loam, eroded hilly phase, in the southeastern part of the county near the Tennessee border.

Use and management.—Dunmore silty clay loam, eroded steep phase, is difficult to till and conserve and is medium in productivity. Practically all of it is used as pasture land, and under common management about 5 acres are required to support one head of cattle. Pasture seems to be the best use for this phase. Because of steepness, the soil is poorly suited to cultivation and is subject to further erosion unless protected by grass or forest.

ELLIBER SERIES

The soils of the Elliber series have developed on valley uplands from weathered material of limestone that contains much chert, and in most places the soils are made cherty by the chert fragments scattered over the surface and mixed through the profile. These soils are associated with soils of the Clarksville and Frederick series and differ from the Clarksville soils in having browner profiles and thinner and less leached surface layers, and from the Frederick soils in having less red and more friable subsoils. They are fairly low in supply of organic matter, moderately low in natural fertility, and acid in reaction.

The upper part of the surface layer is a light yellowish-brown, brown, or grayish-brown friable fine-textured soil about 8 inches thick, and the lower part is lighter in color and somewhat heavier in texture and 4 to 7 inches thick. The 12- to 20-inch subsoil consists of light-brown to yellowish-brown, or mingled light-brown, brown, and light-gray, friable silty clay loam or heavy silt loam. The subsoil is underlain by mottled or mingled light-brown, rust-brown, ochreous-yellow, and light-gray friable silty clay loam, containing small black mineral particles.

The following soils of the series are mapped: Elliber cherty silt loam and its hilly, steep, and very steep phases. Elliber soils are also mapped in the Frederick-Elliber complex.
Elliber cherty silt loam.—This soil is derived from the residue of dissolved dolomitic limestone containing much chert. The many chert fragments on the surface and in the soil came from the parent rock and make the soil open and porous. The relief is undulating and rolling. The slopes, which range from 3 to 15 percent, are in most places favorable for cultivation. External and internal drainage are medium. Areas of the soil are associated in places with areas of Frederick, Lodi, and Bolton soils.

The surface layer consists of brown, grayish-brown, or light yellowish-brown friable silt loam to a depth of 7 or 8 inches, where it becomes lighter in color and slightly heavier in texture and continues to a depth of about 14 inches. Light-gray chert fragments ¼ inch to 3 inches in diameter comprise 25 to 35 percent of this layer, and many of them are scattered over the surface. In forested areas the first inch or so of the surface layer contains a small quantity of organic matter derived from decayed leaves and twigs. The subsoil is light-brown, yellowish-brown, or light brownish-yellow, or finely mingled light yellowish-brown, brown, and gray heavy silt loam or light silty clay loam, containing many 1- to 5-inch light-gray chert fragments. At a depth of 32 to 35 inches the subsoil passes into mingled or mottled light-brown, rust-brown, ochrous-yellow, and light-gray friable silty clay loam, in which are some light-gray chert fragments and many small black mineral particles.

Use and management.—About 75 percent of Elliber cherty silt loam has been cleared of forest. A large part of the cleared land is used for crops and a small part for pasture.

Corn, wheat, hay, and tobacco are the principal crops. The management practices for crops and pasture are similar to those used on Frederick cherty silt loam. The two soils are suited physically to similar crops, and crop yields are about the same where similar management is followed.

Under common management corn averages about 33 bushels an acre; wheat, 14 bushels; timothy and clover mixed, 1¼ tons of hay; lespedeza, 1 ton of hay; and tobacco, 1,150 pounds. With the common management for pasture, about 3 acres afford grazing for one head of cattle.

Elliber cherty silt loam, hilly phase.—The character of the surface relief and the larger number of chert fragments in most places in this soil distinguish it from Elliber cherty silt loam. It is hilly, with slopes of 15 to 26 percent. The slopes, being somewhat steeper than those of the normal phase of the type, make the soil more difficult to cultivate and to conserve. Small eroded areas have formed in some places. This hilly phase is associated in places with areas of Frederick, Lodi, and Bolton soils.

Use and management.—About 65 percent of Elliber cherty silt loam, hilly phase, has been cleared of forest for agricultural use. In the forested areas the trees are mainly white, post, red, and black oaks, hickory, beech, tuliptree, red maple, black locust, and dogwood. Some dead chestnuts are in the stand. Small native vegetation in some fields and pastures includes broomsedge, smilax, wild carrot, aster, dewberry, blackberry, and sassafras.
A large part of the cleared land is used for crops, mainly corn, wheat, hay, and tobacco. Some areas are used for pasture. Under common practices of management, crop yields and carrying capacity of pastures generally average slightly less than on the normal phase of the type. The better practices of management suggested for Frederick cherty silt loam and its hilly phase should be used on this soil.

Elliber cherty silt loam, steep phase.—This steep phase is similar to the normal phase of the type in color, texture, and structure but differs from that soil mainly in having steeper slopes ranging from 26 to 50 percent. This soil is associated in places on cherty ridges with areas of Frederick, Lodi, and Bolton soils.

Use and management.—About 75 percent of Elliber cherty silt loam, steep phase, has been cleared of forest and is used principally as pasture land, with a few small areas in corn. Many cleared areas have been cultivated at one time or another, but with the management practiced the soil became depleted of much of its natural fertility. Owing to the steepness of the slopes, the soil is better suited to pasture than to cultivated crops.

Small native vegetation appearing in pastures includes broomsedge, poverty oatgrass, hawkweed, aster, sheep sorrel, wild carrot, plantain, yarrow, thistle, dewberry, and blackberry.

In the forested areas the trees are mainly scarlet, red, black, and white oaks, Hickory, tuliptree, red maple, beech, black locust, and dogwood. Dead chestnut trees are among the other trees in places.

Under common management for pasture 4 to 5 acres of this steep phase afford grazing for one head of cattle. The pasture produced with common management is undesirable, since the soil is low in organic matter, lime, and other plant nutrients. To improve the grazing the pastures should be either limed and fertilized with a complete fertilizer or well manured. The pastures should also be properly grazed and clipped and the cattle should be fed on them in the dormant grazing season.

Elliber cherty silt loam, very steep phase.—With slopes of 50 percent or considerably more, this soil includes the steepest areas of the type. The soil is separated from the normal phase of the type mainly by steepness of slope. It is similar to the normal phase in color, texture, and structure but has a greater quantity of chert fragments in some places. This very steep phase is associated with areas of Elliber cherty silt loam, steep phase. A few small areas of Frederick cherty silt loam, very steep phase, and Clarksville cherty silt loam, very steep phase, are included with this soil as mapped.

Use and management.—Elliber cherty silt loam, very steep phase, is not suited to cultivated crops nor, except in a few places, to pasture. Its best use is for forest. Practically all the soil is in forest with the same kinds of trees as those on the normal phase.

Emory Series

The soil of the Emory series has developed in close association with Pisgah and Hagerstown soils and has formed from material washed from these soils and deposited near the foot of slopes and along intermittent drainageways. It is acid.
The surface layer consists of brown or dark-brown friable fine-textured soil. It is about 18 inches thick and contains a rather large quantity of organic matter in most places. The subsoil is brown, light-brown, or yellowish-brown friable crumbly heavy silt loam or friable silty clay loam 10 to 20 inches thick. Beneath the subsoil the material consists of mixed yellowish-brown, ocherous-yellow, and brownish-yellow friable slightly compact silty clay loam, containing small black and dark-brown mineral particles. In some places small chert and limestone fragments are mixed with this material. Only one type, Emory silt loam, is mapped.

**Emory silt loam.**—This is a brown friable soil occupying positions at the base of slopes, along intermittent drainageways, and in depressions. It has formed from material washed mainly from Hagerstown and Pisgah soils, and in most areas is associated with these soils. The slopes are nearly level to 5 percent in most areas, but in some areas are 5 to 15 percent. External drainage is slow to medium, internal drainage medium.

To a depth of 15 to 22 inches this soil consists of brown or dark-brown friable silt loam. The subsoil is yellowish-brown, light-brown, or brown friable crumbly silty clay loam, containing many small black mineral concretions. At a depth of 32 to 35 inches the subsoil passes into light yellowish-brown friable crumbly silty clay loam material. This material generally contains more small black concretions than the subsoil.

**Use and management.**—All of Emory silt loam is cleared land in agricultural use. It is easy to till and to conserve, apparently contains a fair quantity of organic matter, has good moisture-holding capacity, and is high in productivity. Most of the soil is used for crops and some for pasture. The principal crops are corn, wheat, hay, and tobacco.

Under common management, corn averages about 55 bushels an acre; wheat, about 20 bushels; timothy and clover mixed, about 2 tons of hay; and tobacco, about 1,700 pounds. With management commonly practiced for pasture, about 2 acres afford pasture for one head of cattle.

**FREDERICK SERIES**

The soils of the Frederick series are developed on valley uplands from residual material mainly of cherty limestone. They are light-colored and light-textured in the surface layer, though the surface layer is heavy-textured in small areas here and there.

These soils are associated with soils of the Hagerstown, Clarksville, and Bolton series. They differ from soils of the Dunmore series mainly in having a somewhat thicker surface layer, more red in the subsoil, and probably a more advanced stage of profile development; and from soils of the Clarksville series in having more red in the subsoil and in being less leached. They differ from soils of the Hagerstown and Bolton series in having a lighter colored surface layer. They are acid in reaction, contain a small quantity of organic matter, and are medium in natural fertility.

The 6- to 8-inch surface layer is light brown or light grayish brown and friable. The upper part of the subsoil is yellowish-brown heavy silt loam or light silty clay loam about 4 inches thick. Beneath this layer the subsoil consists of yellowish-brown, brownish-yellow, or
reddish-brown friable or somewhat tough and plastic silty clay layer about 24 inches thick. The subsoil is underlain by mottled or streaked dark reddish-brown and ochrous-yellow moderately friable parent material. Typically, limestone bedrock lies at a depth of 40 to 70 inches or more, but in some places it is nearer the surface and in many areas it outcrops and makes the soil stony. In most areas many small chert fragments are on the surface and in the soil profile and cause the soil to be cherty.

Frederick cherty silt loam and its hilly and steep phases are mapped. In addition, soil of the Frederick series is mapped in the Frederick-Elliber complex as Frederick-Elliber stony silt loams and Frederick-Elliber stony silt loams, steep phases.

**Frederick cherty silt loam.**—This is a light-colored soil derived from the residue of dissolved cherty limestone. It has a rolling relief, with slopes that range from 8 to 15 percent. External and internal drainage are medium. Although erosion is nowhere severe, small sheet-eroded areas have formed in some places. This soil is associated in places on cherty ridges with areas of Bolton, Lodi, and Elliber soils.

The 6- to 8-inch surface layer consists of light-brown or light-grayish-brown friable silt loam. In forested areas and in many pastured areas, the surface layer to a depth of 1/4 to 1/2 inch is gray silt loam containing a small quantity of organic matter derived from decayed vegetation. In the upper part the subsoil consists of yellowish-brown friable heavy silt loam or light silt clay loam and below a depth of about 11 inches is yellowish-brown, brownish-yellow, or reddish-brown friable or rather tough and plastic silty clay to a depth of 28 to 34 inches. Beneath the subsoil the material consists of mottled or streaked dark reddish-brown and ochrous-yellow fairly friable silty clay loam or silty clay containing chert fragments 1 to 8 inches in diameter. The soil is made cherty by the many light-gray angular chert fragments 1/2 to 2 inches and in places 4 to 6 inches in diameter that are on the surface and in the surface layer. A few grayish-yellow and almost white chert fragments are in the subsoil in most places.

**Use and management.**—About 75 percent of Frederick cherty silt loam has been cleared for agricultural use. Trees on uncleared areas are mainly scarlet, red, black, and white oaks, tuliptree, hickory, beech, red maple, black locust, dogwood, sourwood, and sassafras. Some dead chestnut trees are in the stand in places.

This soil is easy to work and to conserve. It is highly leached, strongly acid, and low in organic matter, phosphate, and potash. Its productivity is medium.

Corn, wheat, and hay are the principal crops, and oats and tobacco are grown to some extent (pl. 8, A). Some areas are used as pasture land. Under common management, corn averages about 33 bushels an acre; wheat, 14 bushels; oats, 20 bushels; clover and timothy mixed, 11/2 tons of hay; lespedeza, 1 ton of hay; and tobacco, 1,150 pounds.

In pastures the predominating plants are dewberry, cinquefoil, broomsedge, blackberry, wild strawberry, smilax, hawkweed, mullein, and hop clover, and less conspicuous vegetation includes orchard grass, bluegrass, and white clover. Under common management for pasture, about 3 acres furnish grazing for one head of cattle.
Except for lighter fertilization and longer crop rotation, the management practices for this soil are similar to those for Pisgah silt loam and Hagerstown silt loam, rolling phase, but the yields are 15 to 20 percent lower.

This soil seems to be best suited to tobacco and small grains; and although the yields are no greater, the quality of the crops generally is superior to that of crops grown on the more productive soils. To grow alfalfa and other legumes the soil must be well supplied with lime and essential plant nutrients. In areas where fertilizer is not used the yields are markedly low compared with those obtained without the use of fertilizer on Pisgah silt loam.

Being low in lime and essential plant nutrients, this soil requires lime and a complete fertilizer for crops that yield well. Some of the best yields generally are obtained under the better practices of management, which include 3-year crop rotations, turning under legumes, and applications of 250 pounds an acre of 4-16-4 fertilizer, or its equivalent, to cornland and wheatland. Short crop rotations in which each crop is somewhat heavily fertilized seem to increase yields better than long rotations in which only the corn and small grain are fertilized.

Frederick cherty silt loam, hilly phase.—In color, texture, and structure this phase is similar to the normal phase of the type, but in most places more chert fragments are on the surface and in the soil and erosion is more active. The soil is separated mainly because of its hilly surface relief, the slopes ranging from 15 to 26 percent. It is less suitable for cultivation than the normal phase, which has milder relief. In a few small areas very few or no chert fragments are on the surface and in the soil. Areas of this hilly phase are distributed over cherty ridges and are associated in many places with areas of Lodi, Bolton, and Elliber soils.

Use and management.—Frederick cherty silt loam, hilly phase, is fairly easy to till and to conserve and is medium in productivity. A large part is used for crops, mainly corn, wheat, and hay. Oats and tobacco are grown to some extent. A fairly large acreage is used as pasture. The forests have been culled of the best timber; the present growth consists of scarlet, red, black, and white oaks, tuliptree, hickory, beech, red maple, black locust, and dogwood. Dead chestnuts are among the other trees in some places.

With few exceptions, management practices, including crop rotations, are similar to those on the normal phase. Under common management, corn gives average yields of about 30 bushels an acre; wheat, 12 bushels; timothy and clover mixed, 11/4 tons of hay; lespedeza, 1 ton of hay; oats, 18 bushels; and tobacco, 1,100 pounds. Under management commonly practiced for pasture, about 31/2 acres supply grazing for one head of cattle.

In addition to better management practices suggested for the normal phase, better practices for this hilly phase should include strip cropping and heavier fertilization of each crop in the rotation. Where feasible the rotations should consist of small grain, clover, and grass. If longer than 3-year rotations are practiced, fertilizer should be applied each year of the rotation. Deep plowing should be practiced.
A. Pasture on Carbo stony silty clay loam.

B. Pasture on Hagerstown stony silt loam, which is poorly suited to row crops because of stoniness.

C. Hayter stony fine sandy loam used for pasture in conjunction with nontillable Carbo and Westmoreland soils. Scattering roughage on the ground for cattle in winter is regarded as good management.
Aids in controlling runoff:

A. Strip cropping on Frederick cherty silt loam, consisting of corn, tobacco, and hay, with grass and forest on the steeper slopes.

B. Contour tillage on Lodi cherty loam, hilly phase.
Frederick cherty silt loam, steep phase.—Comprising the steepest areas of Frederick cherty silt loam this steep phase differs from the normal phase mainly in having steeper relief (26- to 50-percent slopes) and more chert fragments, some of which are 5 to 8 inches in diameter. The soil is poorly suited to cultivation and is more subject to erosion than the normal phase, which has moderate slopes. This steep phase is distributed on cherty ridges, where it is associated with areas of other Frederick soils and with areas of Lodi, Bolton, and Elliber soils.

Use and management.—A large part of Frederick cherty silt loam, steep phase, is used as pasture land, and under common management 4 or 5 acres provide pasture for one head of cattle. A large total acreage has been cropped in times past, and through this practice the soil has lost much of its natural fertility. The quality of the pastures on such soil is low. In areas that have been treated with fertilizer and otherwise well managed the pastures are fairly good.

Some areas are lying idle and others are in forests from which practically all the merchantable timber has been taken. The trees are of the same kinds as those on the normal phase.

This steep cherty soil in its present condition and under common management produces very undesirable pasture in most places. It is moderately low in organic matter, lime, and other plant nutrients and if not properly managed will gradually deteriorate. To improve the grazing, the pastures should be properly grazed, and the cattle fed on them during the dormant season. In addition, the pastures should be either limed and treated with a complete fertilizer or manured well and should be properly clipped. Where, after establishing good pasture, the equivalent of 200 to 300 pounds an acre of triple superphosphate and 1 ton of lime every 4 to 6 years have been applied and proper grazing and other good management have been practiced, marked improvement in the quality of the pasture and its carrying capacity have been obtained. These better management practices seem to bring about some of the best pasture production on this soil.

Frederick-Elliber stony silt loams.—Areas of Frederick and Elliber soils in which 15 to 35 percent of the surface is occupied by small outcrops of limestone are included in this complex. The outcrops are 2 to 5 feet across and rise from a few to about 36 inches above the surface. In a few places the soil between the outcrops is Clarksville. The surface relief is undulating and rolling, the slopes ranging from 3 to 15 percent. External drainage is slow to medium and internal drainage medium. Areas of the complex are associated mainly with areas of Frederick and Elliber soils.

The surface layer is 6 to 8 inches thick and consists of light-brown friable silt loam. The subsoil begins as light brownish-yellow or yellowish-brown heavy silt loam or light silty clay loam and below a depth of about 10 inches becomes yellowish-brown to reddish-brown friable or tough and slightly plastic silty clay loam or silty clay. At 24 to 35 inches the subsoil passes into mingled, mottled, or streaked brown and light-brown or dark reddish-brown, ocherous-yellow, and light-gray friable or fairly heavy silty clay material. In some places limestone bedrock is only a few inches below the surface layer and in others is at 24 to 40 inches. Many light-gray and brownish-yellow chert fragments 1/4 to 2 inches in diameter are on the surface and in the soil in many places.
Use and management.—Nearly everywhere the rock outcrops make Frederick-Elliber stony silt loams unsuitable for cultivation. Small areas here and there that are free or practically free of rock outcrops can be used for cultivation.

Most of the soil is in pasture land. The pasture is fair but not so good as that on Hagerstown stony silt loam. The main pasture plants are bluegrass, white clover, timothy, and orchard grass. Broomsedge, poverty oatgrass, crabgrass, hawkweed, aster, wild carrot, and plantain are present. Under common management for pasture, 3 to 4 acres of this complex afford grazing for one head of cattle.

Being higher in lime than the nonstony Frederick and Elliber soils, this complex produces a more desirable pasture in which there is more bluegrass and white clover. Areas near the limestone outcrops seldom need lime to grow good pasture, although those in the wider spaces between the outcrops need it for best growth. As this complex has not been cropped to any great extent, it is generally in a higher state of productivity than the cropped areas of the nonstony Frederick and Elliber soils.

Frederick-Elliber stony silt loams, steep phases.—This complex of steep phases is similar to the complex of normal phases of these types in character of soil and in limestone outcrops, though in many places the space between the outcrops is somewhat wider. It differs from that complex in being hilly and steep (slopes 15 to 60 percent). This complex of steep phases is found in the same localities as Frederick cherty silt loam, steep phase, and Elliber cherty silt loam, steep phase.

Use and management.—Owing to stronger slopes, Frederick-Elliber stony silt loams, steep phases, are not so well suited to pasture as the complex of normal phases, and in most places the strong slopes and limestone outcrops prevent the use of the land for cultivation.

About 65 percent of the total area has been cleared of forest and is used as pasture land, although some of the cleared land is lying idle. In the forested areas the trees include mainly scarlet, red, black, and white oaks, tuliptree, hickory, beech, red maple, black locust, and dogwood.

The pasture plants are of the same kind as those grown on the complex of normal phases, but the proportion of undesirable vegetation is greater. Pasture yields are fairly low, but can be increased considerably with good management. Under common management, it takes about 5 acres of this complex to graze one head of cattle. Where pasture has been improved by proper fertilization and other good management practices, about 3 acres will graze one head of cattle.

**GREENDALE SERIES**

The soils of the Greendale series are closely associated with soils of the Clarksville, Frederick, Lodi, Elliber, Carbo, Dandridge, and Westmoreland series and are derived from material washed from these soils and deposited at the base of slopes and near intermittent drainageways. Compared with soils of the Emory series, the Greendale soils are lighter in color, more leached, and lower in content of organic matter. Furthermore, they have more distinct profile layers and appear to be in a more advanced stage of development. They are acid.
The surface layer consists of grayish-brown or light grayish-brown fine-textured friable smooth soil 7 to 10 inches thick. The subsoil is brownish-yellow, light brownish-yellow, or yellow friable heavy silt loam to light silty clay loam 20 to 28 inches thick. It is underlain by mottled ochrous-yellow, rust-brown, and gray compact friable silty clay loam. Small angular chert fragments are on the surface and in the soil profile in some places. Greendale silt loam and its sloping phase are mapped.

**Greendale silt loam.**—This is a light-colored friable soil developed from colluvial material washed from soils on the immediate slopes. The slopes range from nearly level to 5 percent. External drainage is very slow to slow and internal drainage medium. This soil has formed from materials washed from Westmoreland, Elliber, Clarksdale, and Lodí soils, and it is associated in places with areas of these soils.

It has a grayish-brown or light grayish-brown friable smooth silt loam surface layer about 8 inches thick. The subsoil consists of yellow, brownish-yellow, or mingled yellow and brownish-yellow friable silty clay loam, containing a few small black mineral concretions. At a depth of about 32 inches the subsoil is underlain by mottled ochrous-yellow, light-gray, and brownish-red slightly compact brittle friable silty clay loam material containing many small black or dark-brown mineral concretions.

Included with this soil as mapped is a dark-colored soil with a 12- to 18-inch surface layer of brown friable silt loam, which is dark brown when wet. The subsoil is light-brown friable silty clay loam to a depth of about 32 inches, where it is underlain by mingled light-brown and brown friable silty clay material containing many small dark-brown mineral particles. This included soil is on foot slopes, in depressions, and near intermittent drainageways, where it has formed from material washed from Bolton soils.

**Use and management.**—Greendale silt loam is very easy to work and to conserve. The organic-matter content is fairly low except in the included dark-colored soil, where it appears to be fair. The soil has fairly good moisture-holding capacity. Its productivity is moderately high.

Practically all the soil is cleared land used mainly for corn, wheat, hay, and tobacco. Under common management, corn yields average about 45 bushels an acre; wheat, 15 bushels; timothy and clover mixed, 1½ tons of hay; lespedeza, 1½ tons of hay; and tobacco, 1,500 pounds. A small total acreage is used for pasture, and with the common management about 2½ acres of the soil produce pasture for one head of cattle.

The use of the included dark-colored soil and the average yields of crops and pasture under the management commonly practiced are the same as for Greendale silt loam.

**Greendale silt loam, sloping phase.**—This soil is similar to the normal phase of the type in physical characteristics, except that in some places the surface layer is not so thick and the subsoil is slightly heavier in texture. It differs from the normal phase mainly in having stronger slopes (5 to 15 percent).
This sloping phase is associated mainly with areas of Westmoreland, Elliber, Clarksville, Dandridge, and Lodi soils and has formed at the foot of slopes from materials washed from these soils. Included with this soil as mapped are sloping areas of dark-colored soil derived from material washed from Bolton soils and deposited on foot slopes. This included soil is similar to the dark-colored soil included with the normal phase of the type, differing mainly in having stronger slopes.

Use and management.—Almost all of Greendale silt loam, sloping phase, and the included dark-colored soil is used for crops, mainly corn, wheat, hay, and tobacco. A small part is used for pasture. The yields of crops and pasture are practically the same for these two soils.

Under common management, corn averages about 42 bushels an acre; wheat, 16 bushels; timothy and clover mixed, 1½ tons of hay; lespedeza, 1½ tons of hay; and tobacco, 1,450 pounds. Under management commonly practiced for pasture, about 3 acres afford grazing for one head of cattle.

HAGERSTOWN SERIES

The soils of the Hagerstown series are on valley uplands and are derived from residual material of limestone having a high calcic content. They are acid and are associated with soils of the Dunmore and Frederick series. In the uneroded soils the surface layer contains a larger quantity of organic matter than the surface layers of these associated soils.

In uneroded areas the 8- to 10-inch surface layer is brown friable silt loam and in eroded areas the 5- or 6-inch surface layer is brownish-red friable rather heavy silty clay loam or clay loam. The upper subsoil is a reddish-brown friable silty clay loam layer 25 to 30 inches thick, and the lower subsoil a brownish-red friable silty clay layer 5 to 30 inches thick, containing small black mineral particles and in places black mineral film. Beneath the subsoil the material consists of friable reddish-brown silty clay, streaked or faintly mottled with ocherous yellow. In some places this layer is absent.

At a depth of 40 to 60 inches or more the soil rests on limestone bedrock, though in places the profile is shallower. In many areas many small outcrops of the bedrock make the soil stony.

The following soils of the Hagerstown series are mapped: The rolling, hilly, and steep phases of Hagerstown silt loam; Hagerstown stony silt loam and its steep phase; and the eroded and eroded hilly phases of Hagerstown silty clay loam.

Hagerstown silt loam, rolling phase.—This soil is derived from the residue of dissolved limestone having a high calcic content and is found in widely scattered areas in low-lying limestone belts. In some places the limestone contains thin layers of shale. The slopes range from 8 to 15 percent, but in few areas from 3 to 8 percent. External drainage is medium to slow and internal drainage medium.

The 8-inch surface layer consists of brown friable mellow silt loam, with apparently a fair quantity of organic matter. A few light-gray chert fragments 1 to 2 inches in diameter are on the surface in places. The subsoil consists of reddish-brown or brownish-red moderately
friable silty clay, becoming more friable at a depth of about 24 inches. At about 40 inches, the subsoil passes into brownish-red or reddish-brown, splotched or mottled with ochaceous yellow, fairly friable silty clay loam soil material, underlain at 60 inches or more by limestone. Many small black mineral particles are in the subsoil and soil material.

The subsoil varies somewhat in characteristics. In places near Gate City it is very tough, compact, and plastic, and in areas near the Tennessee boundary it is heavy and plastic and somewhat redder than elsewhere. In the areas where shale is with the limestone that underlies the soil, the subsoil is yellowish red and somewhat heavy and plastic.

Use and management.—Nearly all of Hagerstown silt loam, rolling phase, has been cleared of forest, mainly for use as cropland. The few remaining trees consist largely of white oak, black locust, black walnut, and redbud.

Owing mainly to mild slopes, friable mellow surface soil, and favorable moisture relations, this rolling phase is easy to till and to conserve and is of generally high productivity.

Corn, wheat, hay, and tobacco are the principal crops. The common management practices include 4- and 5-year crop rotations, but shorter rotations are used to some extent. In the 4-year rotation tobacco is generally grown in small patches in fields of corn, and both corn and tobacco are followed the second year of the rotation by wheat or some other small-grain crop. The small grain is followed either by clover or by clover and timothy mixed, and these crops are harvested for hay the third and fourth years of the rotations. Corn and wheat generally are fertilized with 100 to 200 pounds an acre of 20 percent superphosphate or a 0–14–7 mixture, or the equivalent. Tobacco commonly receives 400 to 800 pounds an acre of 3–8–5 or 4–12–4 fertilizer, or 400 to 600 pounds of 20 percent superphosphate and 10 to 15 wagonloads of manure an acre. Wheat or other small grain following tobacco in the rotation either is not fertilized or is fertilized very lightly, since plant nutrients left in the soil by the tobacco are available to produce good yields of small grains.

Under the common management practiced, corn gives average yields of about 42 bushels an acre; wheat, 19 bushels; timothy and clover mixed, 2 tons of hay; and tobacco, 1,500 pounds. In the small total acreage used for pasture, under common management about 2 acres afford grazing for one head of cattle.

Good management required by this rolling phase includes 3-year crop rotations with a legume or its stubble turned under; contour tillage; fertilization consisting of 300 to 500 pounds an acre of 0–14–7 mixture, or its equivalent, each year of the rotation; and light applications of lime every third or sixth year, preferably before the leguminous crop.

Hagerstown silt loam, hilly phase.—This hilly phase has a slightly thinner surface layer, considerably stronger slopes (15 to 30 percent), and more limestone outcrops than the rolling phase of this type; otherwise the two phases are similar. Owing to hilly relief, however, this phase is less suitable for cultivation and more subject to erosion than the rolling phase. The hilly phase occurs in scattered areas in limestone belts and is associated in places with areas of the rolling phase.
Included with this phase as mapped are a few areas of the hilly phase of Pisgah silt loam. This included soil differs mainly in having a yellowish-brown friable crumbly subsoil instead of the Hagerstown reddish-brown or brownish-red moderately friable subsoil.

*Use and management.*—Hagerstown silt loam, hilly phase, has practically all been cleared of forest and is used mainly as cropland. Corn, wheat, hay, and tobacco are the principal crops. Under common management, which is similar to that for Hagerstown silt loam, rolling phase, corn averages about 40 bushels an acre; wheat, 17 bushels; timothy and clover mixed, 1½ tons of hay; and tobacco, 1,400 pounds. A small total acreage is used for pasture, and with management commonly practiced about 2½ acres of the soil graze one head of cattle.

Requirements of good management are similar to those for Hagerstown silt loam, rolling phase; but on this hilly phase practices for the control of erosion are very important. To this end, longer well-fertilized crop rotations are advisable, in which close-growing crops, as wheat and hay, are grown more of the time. Moreover, where feasible, contour tillage and strip cropping should be followed. When corn is to be planted, it is important that the soil be plowed deeply and cultivated as little as possible in preparing the seedbed so that washing can be controlled during heavy rains.

**Hagerstown silt loam, steep phase.**—In color, texture, and structure, this phase is similar to the rolling phase of this type, but differs in being much steeper (30 to 60 percent), in having thinner profile layers in many places, in containing more outcrops of limestone, and in being less productive. In some places the soil is very shallow, its depth to bedrock being only about 8 inches. Areas of this phase are in limestone belts, and in many places these are associated with areas of other Hagerstown soils.

*Use and management.*—Nearly all of Hagerstown silt loam, steep phase, has been cleared of forest. About 50 percent of the cleared soil is used as pasture land, and some of the rest is lying idle or is grown over with young trees.

Ordinarily about 3 acres of this soil afford grazing for one head of cattle. In a few small areas fertilized with 200 pounds an acre of 20-percent superphosphate, or the equivalent, the pasture was improved and its carrying capacity was somewhat increased. The optimum condition for growing pasture apparently may be had by proper applications of phosphatic fertilizer and by other management, including proper grazing, clipping undesirable herbage, scattering the droppings, feeding cattle on the land in winter, and proper shading with black locust and black walnut trees. These trees have a desirable effect on pasture and seem to protect and conserve the soil better than most other kinds of trees.

This steep phase is easily eroded unless protected by grass or forest, and its best use seems to be for permanent pasture.

**Hagerstown stony silt loam.**—This stony soil, which is Hagerstown silt loam with many limestone outcrops, is undulating and rolling, the slopes ranging from 3 to 15 percent. Many limestone sinks are present. External drainage is slow to medium and internal drainage medium. This stony soil is associated in most places with other Hagerstown soils.
The surface layer consists of brown or light-brown friable silt loam about 6 inches thick. The subsoil is reddish-brown or brownish-red friable or fairly plastic silty clay, containing many black mineral specks. At a depth of about 35 inches the subsoil is underlain by friable reddish-brown silty clay material containing small ocherous-yellow spots. Limestone bedrock lies at about 40 inches, but in some places it is at somewhat less depth and in others it is immediately below the surface layer. Limestone outcrops, ranging from 3 to 4 feet in diameter and rising above the ground a few inches to about 3 feet, occupy 20 to 35 percent of the surface. Limestone fragments 4 to 8 inches in diameter also are on the surface in places.

Use and management.—Because of stoniness most of Hagerstown stony silt loam is unsuitable for cultivation, although small areas as mapped are free of stones, or nearly so, and are cultivable. Practically all of this soil has been cleared of forest, and almost all the cleared soil is used for pasture. The trees in the uncleared areas include mainly white, red, and black oaks, hickory, tuliptree, beech, red maple, black locust, dogwood, black birch, and redbud.

In this county this stony soil is the best pasture land in which limestone outcrops are present in considerable number (pl. 7, B). The pastures on it are among the earliest to be grazed. Under common management, about 2½ acres afford pasture for one head of cattle. The plants consist mainly of bluegrass and white clover. Other vegetation in many pastures includes broomsedge, plantain, crabgrass, wild carrot, and hawkweed.

The common management for pasture on this stony soil generally consists of close grazing, and in a few pastures feeding cattle on the land in winter also is practiced. In a few pastures the management also includes applications of 200 pounds an acre of 20-percent superphosphate per year, or its equivalent.

This stony soil is well supplied with lime for pasture plants, and in most places phosphatic fertilizer is the principal amendment needed for producing good pasture. Under the better practices of management, including proper fertilization, regulated grazing, and feeding cattle on the land during the dormant pasture season, the quality of desirable pasture plants is improved and the carrying capacity of pastures greatly increased.

Hagerstown stony silt loam, steep phase.—The steepest areas of the normal phase of the type are included in this soil. It is similar to the normal phase in color, texture, structure, and limestone outcrops, and differs mainly in having stronger hilly and steep relief (15- to 60-percent slopes). This steep phase is somewhat more erosive than the normal phase. It is associated in many places with areas of other Hagerstown soils.

Use and management.—Hagerstown stony silt loam, steep phase, is unsuitable for cultivation and is less suitable for pasture than the normal phase. About 85 percent of the total area has been cleared of forest and is used for pasture. The trees in the uncleared areas and the vegetation in the pastured areas are of about the same kinds as those on the normal phase, although a greater proportion of the pasture vegetation is undesirable.
The common management for pasture is similar to that practiced on the normal phase of the type, but the carrying capacity is somewhat less. Under the management commonly practiced, about 3 acres of pasture sustain one head of cattle.

**Hagerstown silty clay loam, eroded phase.**—This phase has undulating and rolling relief. The slopes range from 3 to 15 percent, but in most places from 8 to 15 percent. External drainage is medium to rapid and internal drainage medium. This eroded phase is in the southern part of the county southeast, south, and southwest of Fraley Institute.

In uneroded or only slightly eroded areas the surface layer consists of grayish-brown or brown heavy silt loam or light silty clay loam 5 or 6 inches thick. In most places accelerated erosion has removed 50 to 75 percent of the surface layer. In cultivated areas subsoil material is mixed with the surface layer, and the plowed layer consists of reddish-brown rather heavy silty clay loam. The subsoil consists of reddish-brown or yellowish-red heavy somewhat plastic silty clay or clay. At a depth of about 25 inches the subsoil passes into mingled reddish-brown, ochersous-yellow, and gray plastic clay soil material, containing small particles of brownish-yellow partly decomposed shale and small fragments of gray limestone. At 40 to 60 inches limestone underlies the soil, and the soil has formed from weathered material of the limestone.

**Use and management.**—Hagerstown silty clay loam, eroded phase, is nearly all in cultivation. It is easily worked and conserved, but the control of erosion is important. It is high in productivity.

A few areas of the more severely eroded soil are used for permanent pasture and forest, but most of the soil is used for crops, mainly corn, wheat, hay, and tobacco. A small total acreage is used for oats. Under common management, corn gives average yields of 40 bushels an acre; wheat, 15 bushels; oats, 35 bushels; timothy and clover, 2 tons of hay; and tobacco, 1,500 pounds. Under common management for pasture, about 2½ acres of the soil graze one head of cattle.

In the common management of this soil for crops, 4- and 5-year rotations are used, consisting of corn or tobacco the first year, wheat the second year, clover the third year, and grass the fourth year or the fourth and fifth years. Corn and wheat generally are fertilized with 100 to 150 pounds an acre of 4-12-4 mixture or of 20-percent superphosphate, or the equivalent. Tobacco is fertilized with 300 to 600 pounds of 3-8-5 mixture, or with 200 to 400 pounds of 20-percent superphosphate, or the equivalent, and 10 to 20 wagonloads of manure. Clover generally is not fertilized, but in some fields it is seeded in wheat in spring, and the wheat is top-dressed with 200 pounds of 20-percent superphosphate.

Lime is used at the rate of 2 tons an acre in each rotation and is applied previous to the leguminous crop either to cornland or to corn-stubble land prepared for wheat. Contour tillage is practiced in some fields.

The more eroded areas are plowed, seeded, and cultivated as for the less eroded areas and are manured to some extent; but in most of them the yields of most crops are lower.
Management centers in the control of erosion, and along with the crop rotations, fertilization, and liming commonly practiced, the following should be helpful: (1) Plowing under leguminous crops, (2) using manure or other organic-matter mulches on the more severely eroded areas, (3) deep plowing, (4) practicing contour tillage, and (5) seeding and cultivating the more eroded areas so as to obtain good crop growth.

In the past this soil was intensively cropped, and in many areas corn and tobacco were grown continuously. As a result, erosion became serious, and the soil deteriorated to the point where growing these crops was no longer feasible.

**Hagerstown silty clay loam, eroded hilly phase.**—This soil differs from the eroded phase of this type mainly in character of surface relief. It is hilly and has slopes of 15 to 30 percent. Areas of it are in the southern part of the county near the Tennessee boundary.

*Use and management.*—Compared with the eroded phase, Hagerstown silty clay loam, eroded hilly phase, is less favorable for cultivation, more subject to erosion, and less productive of most crops and of pasture.

The soil is used mostly for corn, wheat, and hay, and a small part for pasture. Under common management, which is similar to that for the eroded phase, corn gives average yields of about 35 bushels an acre; wheat, 15 bushels; and timothy and clover mixed, 1½ tons of hay. Under common management for pasture, about 3½ acres supply grazing for one head of cattle.

The fertilizer and lime requirements of this hilly phase are similar to those of the eroded phase; but as the soil is subject to more severe erosion, it is important to use all feasible methods of erosion control for its conservation and improvement. Strip cropping, contour tillage, and crop rotations that include chiefly small grains, legumes, and grasses should be helpful in controlling erosion and in improving the soil for crop use.

**HAYTER SERIES**

The soils of the Hayter series are on valley uplands near the foot of mountains and are associated with soils of the Muskingum, Lehew, and Westmoreland series. They have formed from colluvial material consisting of sandstone and shale fragments and other rock waste from nearby mountainsides. Some of the material is calcareous. Local alluvium also has contributed to the formation of the soils. These soils are similar to those of the Allen and Jefferson series in manner of formation and in position on the landscape, but differ from them in color in that they are brown throughout the profile. They are acid. In most areas sandstone fragments on and beneath the surface make the soil stony.

The surface layer is light-brown or brown friable mellow loam or fine sandy loam 8 to 15 inches thick. The subsoil consists of light yellowish-brown or light-brown friable fine sandy clay or silty clay loam. Beneath the subsoil the material is yellowish-brown friable fine sandy clay, heavy loam, or fine sandy loam mixed with brown and purplish-brown sandstone fragments and greenish-yellow and purplish-brown shale particles.
The following soils of the Hayter series are mapped: Hayter fine sandy loam and its hill phase; Hayter stony fine sandy loam and its hill phase; and Hayter loam.

Hayter fine sandy loam.—This fine sandy loam has formed from weathered material of sandstone and shale fragments that rolled or slumped from slopes and accumulated in rather thick beds in places on valley uplands. It has developed on slopes of 8 to 15 percent, but in some places 3 to 8 percent. External drainage is slow to medium and internal drainage medium. The soil occupies areas on foot slopes in the northern, southeastern, southern, western, and northwestern parts of the county.

The 8- to 10-inch surface layer consists of light-brown or brown friable light-textured fine sandy loam. The subsoil is light yellowish-brown, light-brown, or brown friable fine sandy clay, easily crushed into a soft mass. At a depth of 28 to 32 inches the subsoil is underlain by brown or faintly purplish-brown friable crumbly fine sandy clay or loamy fine sand, intermixed with soft decomposed purplish-brown and brown sandstone fragments 4 to 8 inches in diameter and small thin yellowish-brown shale fragments. A few brown sandstone fragments up to 5 inches in diameter are on the surface and in the surface soil and subsoil.

Use and management.—Nearly all of Hayter fine sandy loam is cleared land used mainly for crops. It is easily worked and conserved and has a rather low content of organic matter. The productivity is moderately high.

Corn, wheat, hay, and tobacco are the chief crops. Under common management, corn averages about 30 bushels an acre; wheat, 12 bushels; timothy and clover mixed, 1½ tons of hay; and tobacco, 1,450 pounds. A small total acreage is used for pasture, and with the management commonly practiced, about 2½ acres of the soil afford grazing for one head of cattle.

Hayter fine sandy loam, hill phase.—In color, texture, and structure this hill phase is similar to the normal phase of the type but has a much stronger relief (15- to 30-percent slopes), slightly thinner layers, and a few more sandstone fragments on the surface and in the profile. In some places the soil grades into limestone soil material at a depth of 20 to 30 inches. A few small areas in which the surface layer is brown friable loam are included with this soil as mapped. The areas are widely scattered and are found on some of the foot slopes in the eastern, southeastern, southern, western, and northwestern parts of the county.

Use and management.—Owing to rather strong relief, Hayter fine sandy loam, hill phase, is less well suited to cultivation than the normal phase and is subject to severer sheet and gully erosion. Its principal use is for crops, consisting mainly of corn and hay. Small parts are used for wheat, tobacco, and pasture.

Under common management, corn averages about 25 bushels an acre; wheat, 11 bushels; timothy and clover mixed, 1½ tons of hay; lespedeza, 1 ton of hay; and tobacco, 1,350 pounds. With common management for pasture, about 3 acres of the soil will graze one head of cattle.
Hayer stony fine sandy loam.—Ranging from nearly level to strongly sloping, this soil throughout most of its extent is sloping to strongly sloping, with gradients of 8 to 17 percent. External drainage is slow to medium and internal drainage medium to rapid. The soil occurs in widely scattered areas on foot slopes in the southeastern and western parts of the county, where it overlies weathered colluvial material consisting of sandstone fragments and other rock waste.

The surface layer consists of light-brown or brown friable light-textured fine sandy loam or brown mellow loam 8 to 10 inches thick. The subsoil is of light yellowish-brown, light-brown, or brown friable fine sandy clay or silty clay loam, passing at a depth of about 28 inches into brown or slightly purplish-brown friable crumbly fine sandy clay, loamy fine sand, or silty clay loam mixed with sandstone and shale fragments. Strewn over the surface and mixed through the surface layer and subsoil are many sandstone fragments, which make the soil stony and in most areas unsuitable for cultivation. These fragments are usually 4 to 8 inches in diameter, although in places on the surface they are larger.

Use and management.—Although Hayer stony fine sandy loam is too stony in most places for cultivation, practically all of it is used as pasture land (pl. 7, C). A few small areas are planted to corn, with fair to low yields. Under common management for pasture, about 3¼ acres afford pasture for one head of cattle.

Hayer stony fine sandy loam, hill phase.—The steepest areas of this soil type make up this phase. It is similar to the normal phase of the type in most respects but has stronger slopes (17 to 35 percent) and in most places slightly lighter color and texture. This hill phase is found on foot slopes in scattered areas in nearly all parts of the county.

Use and management.—Practically all of Hayer stony fine sandy loam, hill phase, has been cleared of forest, and the cleared soil is nearly all used as pasture land. The soil is much less productive of pasture than the normal phase; and under management commonly practiced for pasture, about 5½ acres will graze one head of cattle. Broomedge and briers are common. The soil is too steep and too stony for feasible cultivation, and its best use is for pasture.

Hayer loam.—This loam has formed on foot slopes from weathered material of colluvial beds consisting of sandstone, shale, and limestone materials. It is very gently to strongly sloping, the slopes ranging from 3 to 15 percent. The external drainage is slow to medium and internal drainage medium. The soil is found in widely distributed areas in the eastern, southeastern, southern, southwestern, and western parts of the county.

The surface layer consists of brown friable mellow loam 10 to 15 inches thick, which is light grayish-brown or light purplish-brown when dry and dark brown when wet. A few brown sandstone fragments 2 to 4 inches in diameter are on the surface in places. The subsoil is slightly yellowish-brown, yellowish-brown, or mingled light-brown and brown friable silty clay loam, containing a few black mineral particles. The material of the subsoil is easily crushed into a soft mass. At a depth of about 28 inches the subsoil passes into brown or faintly purplish-brown friable silty clay loam material,
containing small partly decomposed light-green and purplish-red shale particles and yellowish-brown partly decomposed sandstone fragments 2 to 3 inches in diameter.

Use and management.—Hayter loam is very easy to till and to conserve. It apparently contains a fair quantity of organic matter. Almost all of it is used for crops, mainly corn, wheat, hay, and tobacco. Under common management, corn gives average yields of about 40 bushels an acre; wheat, 13 bushels; timothy and clover mixed, 1 1/2 tons of hay; and tobacco, 1,500 pounds. Under management commonly practiced for pasture, about 2 1/2 acres afford grazing for one head of cattle.

HOLSTON SERIES

The soil of the Holston series has developed on terraces from alluvium composed of sand, silt, and clay that came from uplands underlain mainly by noncalcareous sandstone and shale. The profile is lighter colored than in the Sequatchie series. The soil is relatively low in content of organic matter, considerably leached, and acid.

The surface layer consists of light-brown, light grayish-yellow, or light grayish-brown friable sandy-textured soil about 8 inches thick. The subsoil consists of light brownish-yellow, yellowish-brown, or yellow friable fine sandy clay or very fine sandy clay 18 to 28 inches thick. It is underlain by mottled yellowish-brown, rust-brown, and light-gray compact friable fine sandy clay or silty clay loam. Only one type, Holston fine sandy loam, is mapped.

Holston fine sandy loam.—Alluvial material consisting of sand, silt, and clay derived from uplands underlain mainly by noncalcareous sandstone and shale gave rise to this soil. In most places it is nearly level, very gently sloping, and gently sloping, but in some places it is strongly sloping. The slopes range from almost level to 15 percent, but generally are 5 percent and less. In most places the soil lies well for cultivation. External drainage is slow to medium and internal drainage medium. Most of the soil having slopes of 5 to 15 percent is considerably sheet eroded. Areas of this soil are on terraces near the North Fork Clinch River southwest of Duffield and along the Clinch River near Grays Island, Fort Blackmore, Dunganon, and south of Cleveland School.

The surface layer consists of light-brown, light grayish-yellow, or light grayish-brown mellow fine sandy loam, loam, or very fine sandy loam 6 to 10 inches thick. The subsoil is light brownish-yellow, yellowish-brown, or yellow friable crumbly fine sandy clay or very fine sandy clay to a depth of 28 to 34 inches, where it gives way to mottled or mingled ochreous-yellow, rust-brown, and light-gray compact fine sandy clay that is easily crushed into a soft structureless mass. In some places waterworn sandstone fragments 2 to 6 inches in diameter are at a depth of about 48 inches.

Use and management.—Holston fine sandy loam is nearly all cleared land, and a large part is used for crops, mainly corn, wheat, hay, and tobacco. Some areas are used for pasture.

Under the management commonly practiced, including fertilization and crop rotations, corn averages about 35 bushels an acre; wheat, 12 bushels; lespedezia, 1 ton of hay; timothy and clover mixed, 1 1/2 tons of hay; and tobacco, 1,100 pounds. Under common management for pastures, about 4 acres produce sufficient pasture for one head of cattle.
JEFFERSON SERIES

The soils of the Jefferson series have developed on valley uplands near the bases of mountains. They are associated with soils of the Hayter and Allen series and overlie colluvial material consisting of sandstone and shale fragments and other rock debris from nearby mountain slopes. This colluvial material accumulated in beds at the foot of mountains and in some places covers considerable areas of valley uplands. The Jefferson soils differ in color from the Hayter and Allen in having a brownish-yellow profile. They are low in content of organic matter, although in forested areas there is a fair quantity in the first inch or so of the surface layer. This layer has undergone considerable leaching. The soils are acid and low in natural fertility. In most areas light-gray sandstone fragments are on the surface and in the profile in sufficient quantities to make the soil stony.

The 6- to 8-inch surface layer consists of grayish-yellow or slightly brownish-yellow friable sandy-textured soil. The subsoil is light brownish-yellow or yellow friable crumbly fine sandy clay about 24 inches thick. Below the subsoil the material is mottled or streaked brown, brownish-red, and ocherous-yellow friable crumbly fine sandy clay mixed with soft weathered sandstone and shale fragments.

The fine sandy loam and the stony fine sandy loam and their hill phases are mapped.

Jefferson fine sandy loam.—Weathered material of sandstone and shale fragments and other rock waste accumulated in rather thick beds on foot slopes in valley uplands gave rise to this fine sandy loam. It has slopes of 6 to 12 percent. External drainage is slow to medium and internal drainage medium. Areas of this soil are in the northern, southeastern, southern, southwestern, western, and northwestern parts of the county.

The 6- to 8-inch surface layer consists of grayish-yellow or slightly brownish-yellow friable light-textured fine sandy loam, which when dry is light grayish yellow. In forested areas the surface layer to a depth of about 1 inch is gray or grayish brown and contains a small quantity of organic matter derived from decayed leaves and twigs. A few light-brown sandstone fragments 3 to 6 inches in diameter are on the surface in places. The subsoil consists of yellow or slightly brownish-yellow friable crumbly fine sandy clay, containing a few small sandstone fragments. At a depth of 28 to 32 inches the subsoil gives way to mottled or streaked yellowish-brown, dark reddish-brown, ocherous-yellow, and light-gray friable crumbly fine sandy clay material containing a few sandstone and shale fragments.

Use and management.—A large part of Jefferson fine sandy loam is used for corn, wheat, and hay, a small part for tobacco, and a small total acreage for pasture. In wooded areas the trees are chiefly scrub, shortleaf, and pitch pines, Spanish oak, hickory, and tuliptree. Sassafras, sumac, huckleberry, dewberry, blackberry, broomsedge, smilax, and cinquefoil are numerous in old fields.

The soil is fairly easy to conserve and, owing to moderate slope and friable sandy texture, is easy to till. It is low in organic matter and in natural fertility and is very strongly acid.

Under common management, corn averages about 25 bushels an acre; wheat, 11 bushels; timothy and clover mixed, 1 1/4 tons of hay;
lespedeza, 4/5 ton of hay; and tobacco, 1,000 pounds. With management commonly practiced for pasture, about 4½ acres furnish grazing for one head of cattle.

**Jefferson fine sandy loam, hill phase.**—This phase is similar in color, texture, and structure to the normal phase of the type but differs mainly in its stronger slopes (12 to 24 percent) and some thinner layers. It is found on foot slopes in the northern, eastern, southeastern, southern, western, and northwestern parts of the county.

**Use and management.**—Most of Jefferson fine sandy loam, hill phase, has been cleared of forest, and the cleared soil is used for crops and to a small extent for pasture. In the uncleared areas the trees are of about the same kinds as those on the normal phase. Because of strong slopes this soil is less suitable for cultivation than the normal phase. Unless protected it is subject to rather severe sheet and gully erosion. Badly gullied areas have formed in some places.

Corn is the principal crop. Wheat and hay are grown to some extent. Under common management, corn gives average yields of about 20 bushels an acre; wheat, 10 bushels; timothy and clover mixed, 1 1/4 tons of hay; and lespedeza, 3/4 ton of hay. With the management commonly practiced for pasture, about 5 acres afford grazing for one head of cattle.

**Jefferson stony fine sandy loam.**—This stony soil has formed on valley uplands near the foot of mountain slopes from colluvial material consisting of sandstone fragments and other rock waste. It is moderately to strongly sloping, the slopes ranging from 8 to 15 percent. External drainage is medium and internal drainage medium to rapid. The soil is low in organic matter and natural fertility and very strongly acid. It is found in scattered areas on foot slopes, mainly in the southeastern, southern, southwestern, and western parts of the county.

A large part of this stony soil is in forest, and in the forested areas the first inch or two of the surface layer is gray or brownish-gray light-textured fine sandy loam containing organic matter derived from the decay of vegetation. Below this layer the surface layer is slightly brownish-yellow or grayish-yellow friable fine sandy loam to a depth of about 8 inches. When the land is cleared and cultivated the dark-colored upper layer is soon mixed with the plowed layer.

The subsoil consists of yellow or slightly brownish-yellow friable crumbly fine sandy clay. It is underlain at a depth of 28 to 32 inches by mottled or streaked yellowish-brown, dark reddish-brown, ochrous-yellow, and light-gray friable fine sandy clay mixed with many light-brown sandstone fragments 4 to 8 inches across. Some of these fragments are partly weathered and are crumbling into sandy material.

The many 4- to 8-inch light-gray and light-brown pieces of sandstone strewn over the surface and mixed with the surface layer and subsoil make the soil stony. In some places sandstone boulders are on the surface.

**Use and management.**—Jefferson stony fine sandy loam generally is too stony for cultivation. A few small areas from which the stones have been removed are used for corn and garden vegetables. Under the management practiced the yields of corn are low and of garden vegetables fair. Some areas are used for pasture, and under common management about 6 acres sustain one head of cattle. The trees in
the forested areas consist principally of scrub, shortleaf, and pitch pines, Spanish oak, hickory, and tuliptree. The best use for this soil is pasture partly shaded by black locust and black walnut trees.

**Jefferson stony fine sandy loam, hill phase.**—This hill phase comprises the steepest areas of this soil type. It is similar to the normal phase of the type in color, texture, and structure and in having many sandstone fragments, but differs in places in having less thick soil layers. Its slopes range from 15 to 30 percent. Both external and internal drainage are medium to rapid.

Included with this soil as mapped are small areas of Allen stony fine sandy loam, hill phase, the surface layer of which is brownish-yellow or grayish-yellow friable fine sandy loam, and the subsoil brownish-red friable fine sandy clay. Many sandstone fragments are on and beneath the surface.

Also included are areas of stony colluvium, consisting of Muskingum soil material, the slopes of which are much gentler, ranging from 8 to 15 percent. This stony colluvium consists of brown or light-brown soil or earthy material mixed with many light-gray and light-brown angular and subangular sandstone fragments up to 10 inches or more in diameter. Many sandstone fragments also are on the surface. The material of the colluvium was washed or has slumped from areas of Muskingum soils and lies at the base of slopes and along watercourses.

The soil occurs in small to fairly large areas, which are widely distributed and are found on foot slopes in all parts of the county except the central and eastern. The included Allen soil is mostly near Pattonsville, though a few small areas are near the top of Powell Mountain along United States Highway No. 58 and near Pattonsville School. Areas of the included stony colluvium are near Dry Creek north of Duffield, west of Duffield, near Straight Creek and Stony Creek, and near Mabe and Durham Chapel.

**Use and management.**—Because of stones and rather steep slopes, Jefferson stony fine sandy loam, hill phase, is very difficult to till. It is low in organic matter and natural fertility and is very strongly acid. The conservation of plant nutrients is rather difficult. It is poor cropland, and its best use is for pasture and in some places for forest.

Probably 65 percent of the total area is in forest consisting of about the same kinds of trees as those on the normal phase. A large part of the cleared land is idle, some of it is in pasture, and small areas are used for corn and garden vegetables. Corn yields are low, and pasture is relatively poor. Most of the loose stones have been removed from the garden tracts, and the yields of garden vegetables are fair.

**LEADVALE SERIES**

The soils of the Leadvale series are closely associated with those of the Montevallo and are developed from material washed mainly from these soils and deposited at the base of slopes and along intermittent drainageways. They are similar to the Greendale soils in position on the landscape and in color and other features of the profile but differ in character of parent material. They are light in color, considerably leached, low in organic matter, and acid.

The 7- to 10-inch surface layer consists of light-brown to light grayish-yellow friable fine-textured soil. The subsoil is brownish-yellow
or yellow friable silty clay loam or very fine sandy clay 18 to 25 inches thick. Beneath the subsoil is mottled gray, rust-brown, and brownish-yellow somewhat compact friable silty clay loam or very fine sandy clay. Leadvale silt loam and its sloping phase are mapped.

**Leadvale silt loam.**—Formed at the foot of slopes and along intermittent drainageways from material washed mainly from Montevallo soils, this silt loam is found mainly in scattered areas associated with those soils. It is nearly level to very gently sloping, the slopes being 5 percent and less. External drainage is very slow to slow and internal drainage medium.

The surface layer of this soil is about 8 inches thick and consists of light-brown or light grayish-yellow friable silt loam or fine sandy loam. The subsoil is yellow or faintly brownish-yellow friable silty clay loam or fine sandy clay to a depth of 28 to 32 inches, where it is underlain by mottled brownish-yellow, rust-brown, and light-gray compact friable silty clay loam containing a few small black mineral particles in some places.

**Use and management.**—In many places Leadvale silt loam is important cropland because it is about the only smooth farming land available. Owing to the smooth surface and the good working qualities of the plowed layer the soil is easy to till. It is low in organic matter and natural fertility and is very strongly acid. The soil material and plant nutrients are easily conserved. A very large part is used for crops and practically all the rest for pasture. Corn, wheat, hay, and tobacco are the principal crops. Oats and rye are grown on a small total acreage. On some farms the vegetable garden and home apple orchard are on this soil.

Under common management, including fertilization and crop rotations, corn yields average about 35 bushels an acre; wheat, 12 bushels; timothy and clover mixed, 1\(\frac{1}{4}\) tons of hay; lespedeza, 1 ton of hay; and tobacco, 1,100 pounds. The rye yields average about 12 bushels and oats, 18 bushels. The yields of garden vegetables are fairly good.

On land where no management practices for pasture are followed it takes 5 or 6 acres to graze one head of cattle, but under common management 3 or 4 acres are required.

**Leadvale silt loam, sloping phase.**—Similar to the normal phase of the type in color, texture, and structure, this phase differs from that soil mainly in having somewhat stronger slopes (5 to 15 percent). It is associated with areas of the normal phase. External drainage is slow to medium and internal drainage medium. The phase is situated favorably for cultivation but tillage operations, because of stronger slopes, are a little more difficult than on the normal phase.

**Use and management.**—Leadvale silt loam, sloping phase, is low in organic matter and natural fertility and is very strongly acid. The soil material and plant nutrients are fairly easily conserved. The productivity is moderately low. Practically all of it is cleared land, and the main use is for corn, wheat, hay, and tobacco, with some areas used for pasture. Under practices of management commonly followed, including fertilization and crop rotations, corn averages about 32 bushels an acre; wheat, 13 bushels; timothy and clover, 1\(\frac{1}{4}\) tons of hay; lespedeza, 1 ton of hay; and tobacco, 1,100 pounds. Under the lowest level of management it takes 5 to 6 acres to furnish grazing for one head of cattle, but under common practices, 3 or 4 acres.
The soil of the Leheu series is associated with soils of the Muskingum series on mountains. It has formed from residual products of a rock formation consisting of purplish-red sandstone and thin layers of purplish-red shale. The parent rock is noncalcareous in most places. The soil differs from soils of the Muskingum series mainly in color, which is purplish brown or purplish red in contrast with the brown color of the Muskingum. Angular sandstone fragments are commonly on the surface and in the soil, and sandstone outcrops appear in some places. The soil is acid.

The surface layer is purplish-brown or brown friable fine-textured soil 6 to 8 inches thick. The subsoil consists of purplish-brown or purplish-red friable crumbly heavy very fine sandy loam or loam about 15 inches thick, though there is very little or no subsoil in some places. The parent material consists of purplish-brown or purplish-red friable crumbly very fine sandy loam, fine sandy loam, or silt clay loam mixed with sandstone fragments and some shale fragments. Only one type, Leheu stony very fine sandy loam, is mapped.

**Leheu stony very fine sandy loam.**—This purplish-brown to purplish-red soil on some of the mountains and higher ridges is derived from noncalcareous purplish-red sandstone with thin layers of purplish-red shale. The soil is in hilly, steep, and very steep areas, with slopes ranging from 15 to more than 60 percent. External drainage is rapid to very rapid and internal drainage medium to rapid. It is associated in most places with Muskingum soils. Areas are near Dry Creek School, on the south slopes of Powell Mountain and Stone Ridge, and on the north slope of Clinch Mountain.

The 8-inch surface layer consists of purplish-brown or brown friable very fine sandy loam or fine sandy loam, light purplish brown when dry. The subsoil is purplish-brown or purplish-red friable crumbly heavy very fine sandy loam or loam to a depth of 20 to 24 inches. Beneath the subsoil the material consists of purplish-brown or purplish-red crumbly fine or very fine sandy loam. The many brown sandstone fragments 4 to 8 inches across that are strewn over the surface and mixed through the profile make the soil stony. In places sandstone boulders are on the surface and there are small outcrops of sandstone bedrock.

**Use and management.**—About 50 percent of Leheu stony very fine sandy loam is in forest, consisting mainly of chestnut, red, Spanish, and white oaks, dogwood, red maple, and pitch pine. Cleared areas are subject to rather severe erosion unless properly managed. The soil is fairly low in organic matter and is acid. Its natural fertility is low, though not quite so low as that of the associated Muskingum soils.

About 15 percent of the cleared soil is used for crops, and about 55 percent for pasture; the rest is idle land grown over with broom-sedge, smilax, and blackberry.

Corn is the principal crop, and under common management, including light fertilization, the yields range from 10 to 20 bushels an acre. Similar yields of corn are obtained on newly cleared land without the use of fertilizer. Potatoes are grown on a few small areas with fairly good yields. Some areas near Dry Creek School are used for
corn, wheat, and hay grown in rotation, with light applications of
fertilizer, but even with this management the yields are rather low.
Pasture yields are generally poor but somewhat better than on the
associated Muskingum soils. Ordinarily about 7 acres are required
to supply grazing for one head of cattle, but under the common man-
agement it takes about 6 acres, and under the better practices about
5 acres.
Because of the steep slopes, stony character, and low productivity of
this soil, its best use in most places is for forest.

LIMESTONE ROCKLAND

Limestone rockland consists of 90 percent, or slightly more, of lime-
stone outcrops and a small proportion of soil (pl. 9, A). The slopes
occupied range from 8 to 60 percent, or somewhat more. Small areas
of soil or soil material are between the rock outcrops, but the soil
varies in color, texture, and structure. Redcedar and black locust
grow among the limestone outcrops, and sumac grows in many places.
Some deep gullies have formed, and only scanty pasture is available.
Areas of this land type are north of Duffield, in places along the
Robinette Valley Road, along the Clinch River near Carter Ferry
Ford, and near Palmer School and Gravelly Hill Church.

LINDSIDE SERIES

The soil of the Lindside series is in first bottoms near streams,
where it has formed from alluvium consisting of material washed
from uplands underlain mainly by limestone. It is associated with
soils of the Melvin series. Drainage is fairly good in the upper part
of the profile and poor in the lower part. The soil is fairly well
supplied with lime.

The surface layer consists of brown or light-brown friable fine-
textured soil 10 to 14 inches thick. The 10- to 18-inch subsoil is
grayish brown or gray slightly plastic silty clay loam mottled or
spotted with yellowish brown and rust brown. Underlying the subsoil
is dark-gray to light-gray rather heavy plastic silty clay or silty clay
loam containing small rust-brown spots. Only one type, Lindside
silt loam, is mapped.

Lindside silt loam.—This brown friable imperfectly drained soil
is derived from material washed from uplands underlain mainly by
limestone and contains a moderate quantity of organic matter. It is
found in nearly level to gently sloping first bottoms along many of
the small streams in the limestone belts. Lying only a few feet above
the normal level of the adjacent streams, it is subject to overflow.
External and internal drainage are slow to very slow.

The surface layer, about 12 inches thick, consists of brown or light-
brown friable silt loam or heavy silt loam containing dark-brown
spots in places. The subsoil is slightly grayish-brown, mottled or
spotted with dark-brown, friable slightly plastic silty clay loam or
silty clay, passing at a depth of 24 to 28 inches into mottled gray and
brown heavy plastic silty clay. In some places a few small yellowish-
brown chert fragments are in the subsoil and lower layers.

Use and management.—Lindside silt loam is fairly easy to till and
its material and plant nutrients are very easy to conserve. It is
slightly acid. Nearly all of this soil is cleared land. Willow, sycamore, wild cherry, and black walnut are growing in a few places.

A large part of the cleared land is used for crops, mainly corn and hay, and a small part for pasture. Under common management, corn averages about 50 bushels an acre; timothy and clover, about 13/4 tons of hay; and lespedeza, about 1 1/2 tons of hay. Under management commonly practiced for pasture, about 2 acres furnish grazing for one head of cattle.

**Litz Series**

The shallow soils of the Litz series are on hilly, steep, and broken valley uplands associated with soils of the Teas and Westmoreland series. They are derived from decomposed material of a shale formation containing thin widely separated layers of limestone. In many areas small fragments of shale on the surface and in the profile make the soils shaly.

The 4- or 5-inch surface layer is light-brown or grayish-brown fine-textured friable soil. Beneath this layer there is a light-brown or yellowish-brown friable silty clay or silty clay loam layer a few inches to about 15 inches thick. This layer rests on brownish-yellow or greenish-yellow decomposed shale. In many places only a surface layer has formed, which is underlain directly by decomposed shale or shale bedrock.

Litz shaly silt loam and Litz soils in the Teas-Litz complex are mapped.

**Litz shaly silt loam.**—This brown friable relatively shallow soil is derived from a shale formation containing thin layers of limestone at wide intervals. Small shale fragments on the surface and throughout the soil make it shaly. It is dominantly steep and very steep, although a small part is rolling and hilly. Narrow strips are on the south slope of Newman Ridge, near Delight School, and on the south bluff of the Clinch River near Clinchfield. A strip extends from a point just southwest of Canton into Lee County, and a few areas are immediately north of Canton.

The 4- or 5-inch surface layer consists of light-brown or grayish-brown friable silt loam. The subsoil is light-brown or yellowish-brown friable silty clay loam or silty clay to a depth of 8 to 12 inches, where it passes into brownish-yellow or greenish-yellow decomposed shale. In many places where no subsoil has formed the surface layer grades into soft shale. In some places erosion has removed the soil, exposing the soft shale rock. The rock formation that gives rise to this soil contains much less limestone than the formation that gives rise to Westmoreland soils.

**Use and management.**—Practically all of Litz shaly silt loam has been cleared and is used for pasture and crops or is idle. About 55 percent of the cleared land is in pasture, about 15 percent in crops, and about 30 percent is idle. The pasture is poor to very poor, and even under good management about 7 acres are required to furnish grazing for one head of cattle. Corn is the principal crop, but the yields are low and uncertain.

Many areas of this shaly soil that have been cropped to corn alone or have been overgrazed are severely eroded. Grass does not take
hold readily, and when established it is injured from the effects of even a short drought.

Because of generally steep slopes, hazards of erosion, and low moisture-holding capacity, the most feasible use for this shaly soil seems to be forest.

LODI SERIES

The soils of the Lodi series are associated on valley uplands with soils of the Dunmore, Frederick, and Bolton series. They have developed from residual material of a rock formation that consists of limestone or dolomitic limestone and sandstone and that in many areas contains much chert. These soils are differentiated from Dunmore and Frederick soils by the sandy material contributed to their formation by the sandstone in the parent rock and are differentiated from Bolton soils by their lighter color, smaller content of organic matter, and less porous nature. They are relatively low in organic matter, moderate in natural fertility, and acid. Nearly everywhere small chert fragments are so numerous on the surface and in the profile that the soils are rendered cherty. A few small sandstone fragments are on the surface in places.

The 8- to 10-inch surface layer consists of light-brown, light brownish-yellow, or grayish-yellow friable mellow soil. The subsoil, which is 18 to 24 inches thick, in the first 3 to 5 inches is yellowish-brown or slightly reddish-brown heavy loam or very friable fine sandy clay loam, below which it is brownish-yellow, yellowish-brown, or faintly reddish-brown friable fine sandy clay or silty clay loam. Underlying the subsoil is a mottled light-brown, dark brownish-red, och erous-yellow, and light-gray friable crumbly fine sandy clay, in many places underlain at a depth of 40 to 60 inches or more by och erous-yellow and yellowish-brown soft crumbly weathered sandstone.

The following soils of the Lodi series are mapped: Lodi cherty loam and its hilly, steep, eroded steep, and very steep phases.

Lodi cherty loam.—Found on cherty ridges in the valley uplands, this soil is derived from weathered material of a limestone or dolomitic limestone formation containing chert and sandstone. This cherty loam is gently rolling and rolling, the slopes ranging from 6 to 12 percent. External and internal drainage are medium, but in small areas accelerated erosion has removed part of the surface layer. The soil is developed in scattered areas near the Tennessee line. Other areas are near Devils Race Path Branch, north of Gate City, and south of Williams Mill.

The 8- to 10-inch surface layer consists of light-brown, light brownish-yellow, or grayish-yellow friable loam, fine sandy loam, or very fine sandy loam. This layer is very light brown when dry and brown when wet. Owing to the presence of organic matter accumulated from the decay of leaves, twigs, and grass, the surface layer in forested areas to a depth of about half an inch is gray or light gray.

The subsoil in the upper few inches is brownish-yellow, yellowish-brown, or slightly reddish-brown friable heavy loam or very friable fine sandy clay loam. The deeper subsoil is yellowish-brown or slightly reddish-brown friable slightly plastic silty clay or friable fine sandy clay to about 32 inches, where it gives way to mingled or streaked brown, dark reddish-brown, and och erous-yellow friable silty clay loam.
A, Trees, chiefly black walnut, black locust, and redcedar, growing among the rocks on nonagricultural Limestone rockland.

B, Small patches, mainly of corn and tobacco, on steep slopes where Westmoreland soils predominate.

C, Hilly soils of the cherty ridges (Lodi, Frederick, Elliber, Bolton, and Clarksville soils), showing fields allowed to revert for a period of years to unimproved pasture in which shrubby growth of dewberry, blackberry, smilax, poverty oatgrass, and sassafras takes over.
A, Erosion on Lodi cherty loam, caused in a single season by a few hard rains.
B, Rough gullied land reduced from Westmoreland silt loam by accelerated erosion brought about by continuous cropping to corn.
C, Severely gullied area of Bolton loam in which erosion has been arrested by a well-established cover of sericea lespedeza.
This soil is made cherty by numerous light-gray chert fragments 1 to 2 inches (in places up to 6 inches) in diameter scattered over the surface and mixed with surface layer. In addition to the chert fragments there are some grayish-brown or brown sandstone fragments 3 to 6 inches across in some areas. A few chert and sandstone fragments are found throughout the profile in some places.

A few small areas of Clarksville cherty loam soil are mapped with this cherty loam. This soil differs from the Lodi soil mainly in having a yellow or slightly brownish-yellow subsoil.

Use and management.—Lodi cherty loam is rather low in content of organic matter, considerably leached in the surface layer, subject to rather severe erosion when poorly managed, and generally lower in productivity than Pisgah and Hagerstown soils (pl. 10, A). Because of the moderate slopes and friable surface layer, tillage is fairly easy, though in some places chert fragments may interfere somewhat with cultivation. Under good management, the soil material and plant nutrients are fairly easily conserved. The reaction is very strongly to strongly acid.

Practically all of this cherty loam has been cleared for agricultural use. In the uncleared areas the trees consist mainly of white and red oaks, black locust, tuliptree, hickory, red maple, and sassafras.

Most of this soil is used for crops, mainly corn, wheat, and hay, with a small total acreage in tobacco. In some places the soil is used for pasture.

Under common management, including fertilization and crop rotations, corn averages about 35 bushels an acre; wheat, 15 bushels; timothy and clover, 1 ton of hay; lespedeza, $\frac{3}{4}$ ton of hay; and tobacco, 1,100 pounds.

Lodi cherty loam, hilly phase.—Similar in color, texture, and structure to the normal phase of the type, this hilly phase differs from it mainly in relief. Because of stronger slopes (12 to 24 percent) the soil is subject to severer erosion, and tillage is more difficult than on the normal phase. In some places the hilly phase is chertier than the normal phase and contains more sandstone fragments. External drainage is rapid and internal drainage medium. Large areas are on Moccasin Ridge throughout its extent in the county. Smaller areas are near the Tennessee line, on the slopes of Newman Ridge, and on Copper Ridge. Areas that have been rather severely eroded and have lost about two-thirds of the original surface layer are mapped with this soil on Purchase Ridge north of Purchase School.

Use and management.—About 15 percent of Lodi cherty loam, hilly phase, is in forest consisting mainly of white, post, and red oaks, tuliptree, hickory, beech, red maple, black locust, and dogwood. Dead chestnut trees are still standing in places. Probably 15 percent of the soil is idle and grown over with broomsedge, bramble, smilax, sassafras, sumac, and other small native vegetation.

The remaining soil is used largely for corn, wheat, hay, and tobacco, and for pasture. Under the management commonly practiced, including the use of fertilizer and crop rotations, corn averages about 32 bushels an acre; wheat, 13 bushels; timothy and clover, 1 ton of hay; lespedeza, $\frac{3}{4}$ ton of hay; and tobacco, 1,000 pounds. Under common management, 4 or 5 acres of the soil produce sufficient pasture for one head of cattle.
Continuous cropping to corn or tobacco on some areas has caused serious loss of soil material and fertility and has rendered the areas unsuitable for cultivated crops (pl. 8, B).

**Lodi cherty loam, steep phase.**—Areas of this soil type developed on slopes of 24 to 50 percent make up the steep phase. It is similar to the normal phase of the type in physical characteristics, though in many places the soil layers are thinner, and in many places a greater number of chert and sandstone fragments are present. Erosion is more active than on the normal phase. This is the most extensive Lodi soil in the county. Most of it is on slopes of Moccasin Ridge and Copper Ridge. Probably 75 percent is forested, mainly with white and red oaks, tuliptree, hickory, beech, red maple, black locust, and dogwood.

*Use and management.*—Because of steep slopes, tillage of Lodi cherty loam, steep phase, is very difficult and the soil is not very well suited to crops. Its best use is for permanent pasture under most farm conditions. Most of the cleared soil is in pasture or is idle land. Under ordinary conditions about 6 acres are required to furnish grazing for one head of cattle, under common management for pasture about 5 acres, and under the better practices of management only about 3 acres. This steep phase produces less desirable pasture than like phases of Elliber and Frederick cherty silt loams. For best pasture, it requires slightly heavier and more frequent fertilization than these soils. Compared with them it is more erosive, has lost more surface soil through erosion, and has a lower moisture-holding capacity.

**Lodi cherty loam, eroded steep phase.**—This soil includes areas of the steep phase that have lost about three-fourths of the surface layer by erosion. The thin mantle that is left consists of brownish-yellow or faintly reddish-brown friable loam. In some places the surface layer is only slightly eroded and in others the subsoil is exposed. Shallow gullies have formed in places. The slopes are 24 to 50 percent and, in some places, considerably steeper. Most of it is associated with the steep phase of the type on slopes of Purchase Ridge north of Purchase School.

*Use and management.*—Some areas of Lodi cherty loam, eroded steep phase, have been fenced and planted to black locust as a preparatory step in improving the soil and establishing permanent pasture. It is possible to establish permanent pasture economically on some areas by allowing black locust trees to grow large enough, by properly fertilizing the land, and by properly grazing and otherwise managing the pasture. Owing to its steep slopes and eroded condition, this soil is not suited to crops and is probably better suited to forest than to pasture.

**Lodi cherty loam, very steep phase.**—Comprising the steepest areas of the soil type, this phase has slopes of 50 percent or considerably more. It is similar in physical characteristics to the normal phase of the type, but in many places the soil layers are thinner. It contains more chert and sandstone fragments and is subject to more erosion than the normal phase. It is associated with the steep phase of the type.

*Use and management.*—Practically all of Lodi cherty loam, very steep phase, is forested with about the same kinds of trees as found
on the steep phase. A few small areas have been cleared for pasture, but the yield is low. Owing to extremely steep slopes and to hazards of erosion, the best use for this soil is for forest on most farms.

**MELVIN SERIES**

The poorly drained soil of the Melvin series is on first bottoms near streams. It is derived from fine-textured material washed from uplands that are underlain mainly by limestone and is deposited near streams by running water. The soil is associated with soils of the Lindside series, and it is usually slightly acid.

The 8- to 10-inch surface layer is gray or light grayish-brown fine-textured fairly heavy friable soil, containing small rust-brown spots. The subsoil consists of gray heavy-textured plastic silty clay, spotted brown and rust brown. It is 18 to 20 inches thick and is underlain by gray, mottled or spotted with yellowish-brown, brown, or rust brown plastic clay. Only one type, Melvin silt loam, is mapped.

**Melvin silt loam.**—This light-colored poorly drained soil is on low nearly level and very gently sloping first bottoms near some of the creeks and branches in limestone belts. It is subject to overflow by the adjacent streams. The soil has formed from alluvial material derived mainly from uplands underlain by limestone.

The 8- to 10-inch surface layer consists of light grayish-brown or gray fairly heavy silt loam or light silty clay loam, containing small rust-brown spots. The material of this layer is very light gray when dry. The subsoil is gray heavy plastic silty clay, showing small brown or rust-brown spots. At a depth of about 28 inches the subsoil passes into mottled gray, yellowish-brown, and dark-brown heavy plastic clay.

Included with this soil as mapped are small areas of soil in which the surface layer is dark-gray or nearly black silty clay loam and the subsoil dark-gray or very dark-gray heavy plastic silty clay. Both the surface layer and the subsoil contain small dark-brown spots. Had the areas been larger, this included soil would have been mapped Dunning silty clay loam.

**Use and management.**—Almost all of Melvin silt loam is cleared land used for pasture, for which it seems best suited. The pasture is good in both wet and dry seasons. Under common management about 2 acres are required to sustain one head of cattle and under the better practices, 1½ acres.

**MONONGAHELA SERIES**

The soil of the Monongahela series has developed on terraces near streams in association with soils of the Holston series but differs from them mainly in having slower internal drainage and a mottled rather heavy and plastic layer below a depth of 18 to 22 inches. It is fairly well drained above the mottled layer, which is rather poorly drained. Its reaction is acid. Monongahela fine sandy loam is the only type mapped.

**Monongahela fine sandy loam.**—This is a light-colored friable rather slowly drained soil on terraces near streams, where it has formed from alluvial material consisting of sand, silt, and clay derived from uplands underlain mainly by noncalcareous sandstone and shale. The
slopes are gentle to nearly level (5 percent and less). External drainage is slow to very slow, and in undrained areas internal drainage is slow. A large part has been ditched to improve drainage. The soil has developed along the Clinch River near Fort Blackmore and Dungannon and in places along the North Fork Clinch River.

The 7- to 9-inch surface layer is light yellowish-brown friable fine sandy loam or loam containing a few small brown and light-gray spots. The subsoil consists of brownish-yellow to gray, spotted rust brown, compact friable fine sandy clay or very fine sandy clay to a depth of about 20 inches, where it gives way to mottled gray and rust-brown plastic very fine sandy clay or silty clay.

*Use and management.*—Monongahela fine sandy loam lies well for cultivation, and tillage operations are fairly easy. Soil material and plant nutrients are easily conserved. The soil is rather low in organic matter and natural fertility and is strongly acid.

Practically all this soil is cleared land. A large part is used for crops, mainly corn and hay, and a small part for pasture. Under common management, including fertilization, yields of corn average about 25 bushels an acre; timothy and clover mixed, 1 ton of hay; and lespedeza, 1 ton of hay.

Ordinarily, about 7 acres are required to pasture one head of cattle, but under the management commonly practiced, about 5 acres, and under the better practices, about 3 acres.

**MONTEVALLO SERIES**

The soils of the Montevallo series are on hilly and steep valley uplands at the foot of mountains and on mountain slopes and are associated with soils of the Muskingum series. They range from 6 to 14 inches in thickness and are underlain by partly weathered shale or by shale bedrock. A layer 4 to 8 inches thick of light-brown, yellowish-brown, or brownish-yellow friable silty clay loam lies between the surface layer and the parent material in some places. In others the soils consist of only a layer of light-brown or light grayish-brown silt loam on decomposed shale or on shale bedrock at a depth of 5 or 6 inches. Numerous small thin fragments of shale are strewn over the surface and mixed through the soil in most areas. The underlying shale is noncalcareous, and the soils are acid throughout. Montevallo shaly silt loam and its hilly phase are mapped.

**Montevallo shaly silt loam.**—This shallow light-colored soil on lower mountain slopes and foothills is derived from weathered products of noncalcareous shale containing thin layers of noncalcareous sandstone in places. In most areas the many small shale fragments strewn over the surface and mixed through the soil make it shaly. In some areas sandstone fragments are on the surface in sufficient quantities to make it stony. These sandstones rolled from the higher slopes and lodged on the soil. The areas are indicated on the map by symbols. On this steep soil (30- to 60-percent slopes), external drainage is very rapid and internal drainage medium. In cleared areas erosion is active on many slopes, and in many places sheet-eroded areas are evident.

Areas of this soil are on the south slope of Powell Mountain, between Sunbright and Duffield School, north of Duffield School, on the north
slopes and at the foot of the south slope of Pine Ridge, and in Poor Valley.

To a depth of 2 to 5 inches this shaly soil consists of light grayish-brown or light yellowish-brown friable shaly silt loam. This layer is underlain by light-brown, yellowish-brown, or brownish-yellow friable silty clay loam containing small soft decomposed shale fragments. At a depth of about 10 inches this material passes into brown, rust-brown, and light-gray decomposed shale that retains its original structure lines. Yellowish-red, ocherous-yellow, and black mineral material coats the cleavage planes. In some areas the soil consists of a surface layer of light-brown or light grayish-brown friable shaly silt loam 5 or 6 inches thick lying directly on hard platy shale, but in others a layer about 4 inches thick of light-brown friable silty clay loam intervenes between the surface layer and the platy shale. In some areas a comparatively deep soil is underlain at a depth of about 20 inches by decomposed shale.

*Use and management.*—About 85 percent of Montevallo shaly silt loam is in forest consisting of shortleaf, pitch, and scrub pines, Spanish oak, hickory, and tuliptree.

Because of steep slopes tillage is rather difficult, and because of rapid runoff the soil material is hard to conserve. The soil is low in organic matter and natural fertility, has a low moisture-holding capacity, and is difficult to build up and maintain in a productive condition.

Practically all the cleared land is used for pasture, which generally is poor. Even with good practices of management, about 7 or 8 acres are required to graze one head of cattle. Much poverty oatgrass and other short wild grasses are in the pasture. Native vegetation includes much broomsedge as well as smilax, wild carrot, cinquefoil, dewberry, blackberry, sumac, and sassafras. The most feasible use of this soil is generally for forest.

**Montevallo shaly silt loam, hilly phase.**—The hilly phase differs from the normal phase of the type in having gentler relief and milder slopes, which are usually 15 to 30 percent, though in some places 8 to 15 percent. The two soils are associated and are essentially the same in profile characteristics. This hilly phase has rapid external drainage and medium internal drainage.

*Use and management.*—Montevallo shaly silt loam, hilly phase, is rather difficult to till and, unless protected when cleared, is subject to rather severe erosion. It is low in organic matter and natural fertility and has low moisture-holding capacity. Practically all of it has been cleared and is used mainly as pasture land. The pasture generally is poor, and ordinarily about 7 acres are required to support one head of cattle. Much broomsedge is on the pasture land. A few small areas are used for corn, and under the management practiced the yields are low. With the better practices of soil management, the yields of corn would probably average about 20 bushels an acre.

Owing to shallowness, ease of erosion, and naturally impoverished condition the best use of this hilly phase is for forest.

**MUSKINGUM SERIES**

The soils of the Muskingum series are distributed on mountains, and the areas occupied are strongly sloping, steep, and broken. They
are underlain by noncalcareous sandstone containing some noncalcareous shale and developed over weathered material of these rocks. The soils generally are much shallower than those on smooth valley uplands over limestone material. Sandstone fragments are on the surface mixed through the soil in most areas. In forested areas a small quantity of organic matter, derived from decayed leaves and twigs, is mixed with the first inch or two of the surface layer. The soils are low in natural fertility and are acid.

The surface layer is light-brown, light yellowish-brown, or grayish-yellow friable loam or very fine sandy loam 5 to 7 inches thick. The subsoil consists of yellowish-brown, light brownish-yellow, or grayish-yellow friable crumbly heavy loam, very fine sandy loam, fine sandy clay, or silty clay loam 6 to 20 inches thick. Beneath the subsoil the material is mixed brown, yellowish-brown, reddish-brown, and light-gray very friable heavy loam, very fine sandy loam, very fine sandy clay, or silty clay loam mixed with light-brown and brownish-yellow decomposed sandstone or sandy shale.

The following soils of the Muskingum series are mapped: Muskingum loam, Muskingum stony loam, Muskingum very fine sandy loam, and Muskingum stony very fine sandy loam.

Muskingum loam.—A brown friable soil on 30- to 60-percent slopes in the Cumberland Plateau in the northern part of the county, this loam was formed from weathered material of a rock formation consisting of noncalcareous sandstone and a small proportion of noncalcareous shale. This soil is generally somewhat deeper to bedrock than Montevallo soil. External drainage is very rapid and internal drainage medium. The soil is located in the northern part of the county, mainly southeast and southwest of Brushy Knob.

The surface layer is light yellowish-brown or light-brown friable loam about 6 inches thick. In forested areas the first inch or two of the surface layer is grayish-brown light-textured loam containing an appreciable quantity of organic matter derived mainly from decayed leaves and twigs.

The subsoil consists of light-brown or yellowish-brown friable crumbly heavy loam or friable fine sandy clay to a depth of about 24 inches. It is underlain by mingled yellowish-brown, dark reddish-brown, and light-gray friable crumbly fine sandy clay or heavy fine sandy loam mixed with brown partly decomposed sandstone fragments 4 to 8 inches across. A few 4- to 6-inch sandstone fragments are on the surface and in the surface layer and subsoil. A few small areas in which the texture of the surface layer is very fine sandy loam and that of the subsoil very fine sandy clay are mapped with this soil.

Use and management.—Cut-over forest covers nearly all of Muskingum loam, the trees consisting largely of scarlet, black, and white oaks, pitch pine, red maple, sourwood, hickory, and tuliptree. Mountain-laurel, bramble, and huckleberry are conspicuous in the undergrowth.

This loam is subject to rather severe erosion when cleared of forest, and tillage operations are difficult. It is low in organic matter and natural fertility.

A few small areas have been cleared and are used as pasture land. The pasture generally is poor. Under the better practices of manage-
ment 6 or 7 acres would be required to supply grazing for one head of
cattle. The best use for this soil is forest.

**Muskingum stony loam.**—The residual products of weathered non-
calcareous sandstone and shale gave rise to this stony loam. The par-
ent rock consists of a light-brown sandstone formation containing thin
beds of dark-green shale. In some places the sandstone contains mica
and a mineral that appears to be feldspar. The soil is prevailingly
steep, the slopes ranging from 30 to 60 percent. In a few small areas,
however, it is hilly, and here the slopes are 15 to 30 percent. It has
rapid to very rapid external drainage and medium to rapid internal
drainage. This stony loam is the most extensive Muskingum soil in
the county. It is confined in development to the northern part of the
county, with large areas southeast and southwest of Brushy Knob.

In forested areas the surface layer to 1 or 2 inches in depth is grayish-
brown light-textured loam, containing a small quantity of organic
matter derived from decayed leaves and twigs. Deeper, the surface
soil is light yellowish-brown friable loam to a depth of 6 or 7 inches.
The subsoil consists of light-brown or yellowish-brown friable crumbly
heavy loam, fine sandy clay, or friable silty clay loam. At a depth of
18 to 24 inches the subsoil grades into mingled yellowish-brown, dark
reddish-brown, and light-gray friable crumbly heavy fine sandy loam
or fine sandy clay, or friable silty clay loam intermixed with soft
weathered brown sandstone fragments, and in places greenish-yellow
shale fragments.

Small mica flakes are in the soil in some places. A great many light-
gray and brown sandstone fragments 4 to 6 inches across are strewn
over the surface and are in the surface soil and subsoil. These rock
fragments make the soil stony. Small outcroppings of the sandstone
bedrock appear in the soil in places. In cultivated areas the plowed
layer is light grayish-brown or light-brown friable loam.

**Use and management.**—Almost all of Muskingum stony loam is cut-
over forest land, and the trees and undergrowth are of about the same
kinds as on Muskingum loam. When cleared of forest, it is subject to
rather severe erosion unless protected by a cover of vegetation or by
other means of erosion control. Steep slopes and stoniness make
tillage operations difficult. The organic-matter content of the soil is
low, its natural fertility poor, and its moisture-holding capacity fairly
low. Productivity of crops and pasture is low and difficult to build
up and maintain.

Because of the unfavorable external and internal characteristics of
this stony soil, its best use is for forest.

**Muskingum very fine sandy loam.**—This is a light-colored friable
soil on 30- to 60-percent slopes mainly in the northern part of the
county. In some places the slopes are milder, ranging from 15 to 30
percent. It is derived from noncalcereous sandstone containing sandy
shale in places. The total area is relatively small.

The 6- to 7-inch surface layer consists of grayish-yellow or light
grayish-brown friable very fine sandy loam. In forested areas the
first inch of this layer is dark gray and contains a fairly large quantity
of organic matter, consisting of decayed leaves, twigs, and grass.

The subsoil is grayish-yellow or light brownish-yellow friable heavy
very fine sandy loam to a depth of about 18 inches, where it passes into
light-brown friable fine sandy clay or heavy fine sandy loam containing brownish-yellow, reddish-brown, and brownish-red decomposed sandstone and in places sandy shale. At a depth of 28 to 35 inches this material is underlain by sandstone and in places by sandy shale bedrock. A few light-brown sandstone fragments 1 to 2 inches across are on the surface and in the surface soil, and in many areas some small brownish-yellow, gray, and reddish-brown partly weathered sandstone or sandy shale fragments are in the subsoil. In a few small areas the subsoil is brownish red, and in others small mica flakes appear in the lower part of the profile.

Included with this soil as mapped is a small area east of Duffield in which the surface layer is friable silt loam and the subsoil friable silty clay loam.

Use and management.—Approximately 40 percent of Muskingum very fine sandy loam is in cut-over forest, composed mainly of chestnut, red, Spanish, and white oaks, dogwood, pitch pine, and red maple. The cleared land is used for crops and pasture or is idle land. Tillage operations are rather difficult, and areas cleared of forest are subject to considerable erosion unless protected. The soil is low in organic matter, natural fertility, and moisture-holding capacity.

Of the cleared land, about 80 percent is used for corn and about an equal acreage for pasture. The rest is idle and much of it has a cover of broomedge, dewberry, blackberry, sassafras, sumac, cinquefoil, yarrow, mullein, sheep sorrel, and other small native plants. Many small pines are on some areas.

Under the management commonly practiced, including light fertilization, corn produces 10 to 15 bushels an acre. Tobacco is grown on a few small areas, and under management practices that include fairly heavy applications of a complete fertilizer, the yields range from 700 to 800 pounds an acre. The pasture generally is poor, and under the better practices of management 6 or 7 acres would graze one head of cattle.

Owing to the generally unfavorable qualities of this soil for crops and pasture its best use in most places is for forest.

Muskingum stony very fine sandy loam.—The numerous rock fragments that make this soil differentiate it from Muskingum very fine sandy loam. The slopes are steep (30 to 60 percent) though a few areas have milder gradients (15 to 30 percent). External drainage is rapid to very rapid and internal drainage medium to rapid. A very large part of the total area is cut-over forest land. Areas of this Muskingum soil are on Powell Mountain, Stone Ridge, Pine Ridge, and the southeast slope of Clinch Mountain.

In forested areas the surface layer to a depth of about 1 inch is gray or dark-gray friable very fine sandy loam containing a fairly large quantity of organic matter accumulated from decayed leaves, twigs, and other vegetation. Below this the surface soil consists of grayish-yellow or light-brown friable very fine sandy loam to a depth of 5 to 7 inches. In cultivated land the plowed layer is light-brown or very light-brown friable very fine sandy loam.

The subsoil consists of light brownish-yellow or grayish-yellow friable crumbly very fine sandy clay or heavy very fine sandy loam containing a few soft decomposed brownish-yellow and reddish-brown
pieces of sandstone and, in places particles of shale. At a depth of about 18 inches the subsoil passes into friable crumby yellowish-brown very fine sandy clay material mixed with small decomposed sandstone and, in places, shale fragments. The large number of hard light-gray and light-brown sandstone fragments, 4 to 8 inches across, scattered over the surface and mixed with the surface layer and subsoil make the soil stony.

Included with this soil as mapped are small areas of stony soil in which the surface layer is friable silt loam and others in which it is friable fine sandy loam. Also included are small areas of stony soil in which the surface layer is purplish-brown friable very fine sandy loam and the subsoil purplish-red friable very fine sandy clay or fine sandy clay.

*Use and management.*—Probably 85 percent of Muskingum stony very fine sandy loam is in forests mainly of chestnut, red, Spanish, and white oaks, dogwood, red maple, and pitch pine. Steep slopes and stoniness make tillage difficult. The soil is subject to rather severe erosion in cultivated areas unless careful management is practiced to control runoff. It is low in content of organic matter and in natural fertility and has a moderately low moisture-holding capacity. Productivity is difficult to build up and maintain.

About 65 percent of the cleared soil is lying idle, and the rest is used mainly for corn. In many places the idle land is grown over with broomedge, blackberry, and other small native plants.

Corn produces 10 to 15 bushels an acre with light fertilization and other practices of management. It is grown for 2 or 3 years in succession, and then the land is allowed to lie idle a few years before corn is planted again. A few small areas are used for tobacco, which produces 700 to 800 pounds an acre with rather heavy applications of a complete fertilizer and with other practices of management. In some areas many of the stones were removed before cultivation was attempted.

Because of steep slopes, stones, and low fertility, this soil is more suitable for forest use than for crops or pasture.

**PHILO SERIES**

The soil of the Philo series occupies first bottoms near streams and is derived from alluvial material washed from uplands underlain mainly by noncalcareous sandstone and shale. It is fairly well drained in the upper part of the profile and poorly drained in the lower part. Its reaction is acid.

The surface layer consists of brown, grayish-brown, or light-brown friable mellow soil 8 to 12 inches thick. The subsoil is brown friable crumbly heavy fine sandy loam or fine sandy clay or friable silty clay loam, mottled or spotted with gray, 16 to 20 inches thick. It is underlain by gray slightly plastic friable fine sandy clay or silty clay loam containing small rust-brown and ochereous-yellow spots. In some places gray plastic clay and in others sand and gravel underlie the soil at a depth of about 40 inches. Philo fine sandy loam is mapped.

**Philo fine sandy loam.**—This brown friable mellow soil in first bottoms near some of the streams is derived from alluvium composed of materials washed from uplands underlain mainly by noncalcareous sandstone and shale. External drainage is very slow to slow and in-
ternal drainage slow to very slow. In many places it is subject to overflow by the adjacent streams. Areas of this soil are along the Clinch River east and west of Fort Blackmore and near Dungannon and along a few of the smaller streams.

To a depth of 8 to 12 inches this soil consists of brown, grayish-brown, or light-brown friable mellow fine sandy loam. Beneath this layer is brown, mottled or spotted with gray, friable heavy-textured fine sandy loam or friable fine sandy clay or silty clay loam to a depth of about 28 inches. Underlying this layer is gray, mottled or spotted with rust brown, slightly plastic fine sandy clay or silty clay loam material, in places containing a few black mineral particles and black mineral film.

Included with this soil as mapped are small areas of Philo silt loam, which differs from it mainly in having finer texture and slightly less friable consistence.

Use and management.—Practically all of Philo fine sandy loam is cleared land in agricultural use. Willow and alder are near the streams in many places. This soil is easily tilled, and the soil material and plant nutrients are easily conserved. It contains a fair quantity of organic matter, is acid, and is moderately productive of the crops commonly grown. Over a large total area drainage has been improved by ditching.

About 65 percent of the total area is used for crops, mainly corn, and the rest for pasture. Under common management, corn averages about 28 bushels an acre, and 3 acres of pasture are necessary to furnish grazing for one head of cattle. Wheat is grown on a few small areas, and under common management, including fertilization, yields about 10 bushels an acre; tobacco, grown on a few of the best drained areas and given fairly heavy applications of a complete fertilizer, produces about 1,500 pounds.

**PISGAH SERIES**

Soil of the Pisgah series occupies some of the lowest positions on the valley uplands, where it is associated with soils of the Carbo and Westmoreland series. There is a rather large quantity of organic matter in the surface layers and the soil throughout is acid.

The surface layer, about 8 inches thick, consists of brown friable mellow soil. The subsoil is yellowish-brown friable crumbly slightly plastic silty clay 28 to 32 inches thick, containing a few small black mineral particles and in places black mineral film. Underlying the subsoil is light yellowish-brown, or faintly mingled ocherous-yellow, brown, and light-gray, friable silty clay loam, containing some small black mineral particles and black mineral film. Small angular light-yellow and almost white chert fragments are in this material in places.

Limestone bedrock underlies the soil at a depth of 40 to 60 inches or more. In places the limestone contains small chert fragments, which are left in the parent material when the limestone dissolves. Pisgah silt loam is mapped.

**Pisgah silt loam.**—This brown friable mellow soil has formed on some of the lowest positions in the valley uplands from residual material of limestone high in calcic content. This silt loam is rolling, with slopes of 8 to 15 percent; though in a few areas it is undulating,
with slopes of 3 to 8 percent. Both external and internal drainage are medium, but in some of the smoother areas drainage is slow. Erosion has affected the soil to some extent and has been most active in small spots near some of the limestone sinks. The soil is found in scattered areas in many parts of the limestone belt.

The surface layer consists of brown or dark-brown friable mellow silt loam about 8 inches thick. The subsoil is yellowish-brown friable crumbly silty clay or heavy silty clay loam containing many small black mineral particles. At a depth of 28 to 35 inches the subsoil passes into finely mingled yellowish-brown and dark reddish-brown friable crumbly silty clay loam material containing many small dark-brown and black mineral particles and some yellowish-brown chert particles one-eighth to one-quarter inch in diameter. In many places a few small light yellowish-brown chert particles are in the surface layer and subsoil. In some small areas a brownish-red fairly hard silty clay is reached at a depth of 18 to 36 inches.

Use and management.—Practically all of Pisgah silt loam has been cleared for crops and pasture. The few trees that remain here and there are mostly black locust, white oak, and redecder.

This soil is considered one of the best in the county for crops and pasture. It is inherently fertile and highly productive of most crops locally grown, and is especially well suited to corn, red clover, and alfalfa. Owing chiefly to smooth slopes, friable mellow surface soil, and favorable moisture relations, the soil is easy to till and easy to conserve under cultivation. Although poor soil management in some areas has reduced the fertility, in most areas it is fairly high and the soil can be built up to the optimum of productivity by good management.

Corn, wheat, tobacco, and clover, or clover and timothy mixed, are the principal crops. Four- and five-year crop rotations are most commonly practiced, though shorter rotations are coming into use. In the 4-year rotation, tobacco generally is grown in small patches in cornfields, and both corn and tobacco are followed the second year of the rotation by wheat or other small-grain crop. The small grain is followed by clover, or by clover and timothy mixed, and harvested for hay the third and fourth years. Some corn is grown without the use of mineral fertilizer or manure, but corn generally is fertilized with 100 to 150 pounds of 20-percent superphosphate or 0–14–7 mixture, or the equivalents, an acre.

This fertilization also is given wheat, and the fertilizer is applied to corn and wheat in the first 2 years of the rotations. Tobacco is commonly fertilized with 400 to 800 pounds an acre of 3–8–5 or 4–12–4 mixture, or 400 to 600 pounds of 20-percent superphosphate and 10 to 15 tons (wagonloads of manure), or the equivalents. Wheat or other small grain that follows tobacco in the rotation either is not fertilized or is fertilized very lightly, since plant nutrients left in the soil by the tobacco are sufficient to produce good yields of small grains. Except for leguminous crops, very little lime is required on this soil.

This management is considered fairly good, and under it corn generally produces 30 to 70 bushels an acre; wheat, 8 to 28 bushels; tobacco, 1,000 to 2,200 pounds; and hay crops, 1 to 2¼ tons. The larger yields of the crops are obtained when the season is most favorable and where applications of mineral fertilizer and manure are heavier.
Good management includes a 3-year crop rotation in which a legume or its stubble is turned under; contour tillage is practiced; 200 pounds an acre of 0–14–7 fertilizer, or its equivalent, are applied each year and the land is treated with a light application of lime every third or fourth year, preferably before the leguminous crop. Corn, small grain, and hay crops grown in this rotation consistently give greater yields than in the rotations commonly practiced.

These management practices followed over a period of 24 years on a soil closely related in physical characteristics indicate that they would be best for this soil and for the specified crops. When tobacco or alfalfa is grown, slightly more potash may be needed for best results. It may also be necessary to include nitrogen in the fertilizer, unless manure has been used in adequate amounts or a legume plowed under.

POPE SERIES

Occupying first bottoms near streams in association with soils of the Philo and Atkins series, the soils of the Pope series are derived from alluvium composed of material washed from uplands underlain mainly by noncalcareous sandstone and shale (pl. 5, B). They are well drained, moderately low in content of organic matter, and acid.

The 8- to 10-inch surface layer consists of brown, light-brown, or dark-brown fine-textured friable mellow soil. The subsoil is light-brown, brown, or slightly yellowish-brown friable heavy fine sandy loam or silt loam or friable fine sandy clay or silty clay loam 16 to 25 inches thick. Beneath the subsoil the material consists of mingled brown, rust-brown, and light-gray friable crumbly fine sandy clay or friable silty clay loam, fine sandy loam, or loamy fine sand.

In some places small light-brown water-worn sandstone fragments are on the surface and mixed through the profile. Pope fine sandy loam and Pope silt loam are mapped.

Pope fine sandy loam.—Located in fairly low first bottoms, this brown mellow soil is subject to flooding in many places by the adjacent streams during unusually heavy rains. It is nearly level to very gently sloping, with dominant slopes of 0 to 3 percent. Some slopes up to 5 percent are included. External drainage is very slow to slow and internal drainage medium.

A relatively small total area of soil that differs from this type mainly in having a much coarser texture throughout is mapped with it. Had it been more extensive, it would have been mapped as Pope sandy loam.

This soil and the included sandy loam have formed from alluvial material consisting of sand, silt, and clay derived from uplands underlain mainly by noncalcareous sandstone and shale. Areas of the fine sandy loam are along the Clinch River and on islands in that river and along the North Fork Clinch River, the North Fork Holston River, and some of the smaller streams. Areas of the included sandy loam are along Stock Creek, the Clinch River, and the North Fork Holston River.

To a depth of 10 to 12 inches the soil is brown friable mellow fine sandy loam, light brown when dry. The subsoil is light-brown friable crumbly heavy fine sandy loam or friable fine sandy clay to a depth of 28 to 35 inches. Underlying this layer is light-brown friable
fine sandy loam showing brown spots. In some places this material contains many brown water-worn sandstone and quartzite fragments 2 to 5 inches across. A few light-brown sandstone and quartzite pebbles and larger water-worn fragments are on the surface in places.

Use and management.—Owing to the friable, mellow surface soil and nearly level to gently sloping surface, Pope fine sandy loam is easily tilled; and owing to its mild slopes and ready absorption of water, the control of erosion offers practically no problem. The soil is moderately low in organic matter, acid, and moderate to fairly high in productivity.

Practically all this soil is cleared land. Sycamore and willow grow near the streams in many places. Nearly all the soil is used for corn and hay crops, with a small total acreage for wheat and tobacco. Under the management commonly practiced, including the use of fairly low to moderate applications of fertilizer, corn averages about 40 bushels an acre; wheat, 11 bushels; timothy and clover, 1½ tons of hay; lespedeza, 1 ton; and tobacco, 1,400 pounds.

Pope silt loam.—Located in first bottoms only a few feet above the normal level of the streams, this soil is subject to flooding in many places. It is derived from sand, silt, and clay washed from uplands underlain by noncalcareous sandstone and shale, and in places by limestone, and deposited near streams by running water. This silt loam is finer and in many places slightly darker than Pope fine sandy loam. The soil is nearly level to gently sloping, the strongest slopes being only about 5 percent. External drainage is very slow to slow and internal drainage medium. Areas are found along the North Fork Clinch River, Copper Creek, Ketron, Fowlers, Venus, and Timbertree Branches, and some of the other streams.

To a depth of 8 to 10 inches the soil consists of light-brown, brown, or dark-brown friable silt loam. The subsoil is light-brown or brown heavy silt loam or friable fine sandy clay to a depth of about 32 inches, where it passes into friable light-brown silty clay loam or fine sandy clay material containing small brown water-worn sandstone and shale fragments. In places a few small water-worn sandstone fragments are on the surface and in the surface soil.

Use and management.—Tillage on Pope silt loam is easy, and soil material and plant nutrients can be easily conserved. The soil is acid, fairly well supplied with organic matter, and moderately high in productivity. It is nearly all used for crops, mainly corn and hay, with a small part in wheat and tobacco. The crop yields generally are slightly higher than on Pope fine sandy loam.

Under common management including the use of fertilizer, corn yields average about 45 bushels an acre; wheat, 12 bushels; timothy and clover mixed and lespedeza alone, 1½ tons of hay; and tobacco, 1,500 pounds.

RIVERWASH

Riverwash includes alluvial material in low areas near some streams. It consists of light-brown fine or medium sand mixed with many light-brown sandstone and quartzite pebbles and larger water-worn fragments. There are water-worn limestone fragments in places. Small hummocks and sand bars occur here and there. No definite soil has formed, and new material is deposited by overflow of the
nearby streams. Practically all of the Riverwash is in places along the Clinch River and the North Fork Holston River, and on islands in these rivers. It is not used for crops. Birch and sycamore trees and elder and alder bushes grow in most places. Its best use is for trees.

ROLLING STONY LAND (LIMESTONE MATERIAL)

Many small outcrops of gray limestone bedrock occur in the soil of Rolling stony land (limestone material). The soil is mainly the residue of dissolved limestone. The relief ranges from nearly level to hilly but is dominantly rolling and hilly, the slopes being 3 to 30 percent. External drainage is slow to rapid and internal drainage medium to slow. Erosion is active in some places.

This rolling stony land is distributed throughout the limestone belts of the county. The soil consists of brown friable silt loam or heavy silt loam, passing at 5 or 6 inches into brownish-yellow or faintly reddish-brown silty clay or silty clay loam material. In some places only the brown silt loam layer has formed, and it is underlain by limestone. The outcrops of limestone, 2 to 5 feet across and standing above the surface a few inches to 3 feet, occupy 40 to 90 percent of the surface.

Use and management.—Rolling stony land (limestone material) is too stony for cultivation. About 75 percent of it is used for permanent pasture, and the rest is forested. Black locust, black walnut, and red cedar are common trees.

Bluegrass, white clover, and crabgrass are the dominant pasture plants. Some of the earliest and latest grazing in the county is afforded by this stony land, possibly because of the lime and other plant nutrients available near the limestone outcrops. Under common management for pasture, about 5 acres furnish grazing for one head of cattle.

Good management requirements for optimum pasture production in most places include mainly light applications of phosphatic fertilizer and proper grazing. A scattering of black locust and black walnut trees seems to be beneficial to the pasture.

ROUGH GULLIED LAND (LIMESTONE AND SHALE MATERIALS)

Areas of 2 to 5 acres in which the land is so badly gullied that it would be extremely difficult to restore it for cultivation are included in Rough gullied land (limestone and shale materials). Some areas could be restored for pasture use, but for most of them tree growth is the only feasible use. The gullies have penetrated the weathered limestone and shale material and in some places have reached bedrock. From many of the areas between the gullies erosion has removed part or all of the surface layer and in some places part of the subsoil. Small virtually uneroded patches remain here and there. A few black locust and scrub pine grow in places. This rough gullied land is rolling to steep, with slopes ranging from 8 to 60 percent. Much of it is in areas of Litz shaly silt loam, although some is in areas of the eroded phases of Teas-Litz silt loams and Bolton loam.

ROUGH STONY LAND (LIMESTONE MATERIAL)

Rough stony land (limestone material) differs from Rolling stony land (limestone material) mainly in having steeper slopes (30 to 60
percent or more) and slightly shallower soil in most places. It is too steep and too stony for cultivation and for feasible pasture use. This land type is found throughout the limestone belts of the county and in most places is associated with areas of Rolling stony land (limestone material).

Use and management.—About 95 percent of Rough stony land (limestone material) is forested, mainly with black locust, dogwood, redecedar, and black walnut. Some of the cleared land is used for permanent pasture and the rest is lying idle. The carrying capacity of the pastures is low. Although the pasture plants are sparse, in some places they are of good quality. When cleared of forest this land type is subject to severe erosion, and feasible methods of erosion control are difficult to apply.

ROUGH STONY LAND (MUSKINGUM SOIL MATERIAL)

Soil on hilly, steep, and broken mountainsides on which there are many sandstone boulders and smaller sandstone fragments and in many places outcrops of sandstone bedrock are included in Rough stony land (Muskimgum soil material). This rough stony land is on Powell Mountain, Stone Ridge, Pine Ridge, and Clinch Mountain on slopes of 15 to 60 percent.

As almost all of this land type is in forest, the first inch of the surface layer of the soil in most places is gray or dark-gray friable very fine sandy loam or loam, containing a small quantity of organic matter derived from decayed leaves and twigs. Deeper, the surface layer is light-brown or yellowish-brown friable very fine sandy loam or loam about 5 inches thick. Below this layer there is a light-brown or brownish-yellow friable very fine sandy clay or heavy loam soil material to a depth of 12 to 20 inches, where it gives way to disintegrated sandstone. In many places this material is absent and the surface lies on decomposed sandstone.

Use and management.—Practically all of Rough stony land (Muskimgum soil material) consists of forest from which nearly all the best timber has been removed. The remaining trees are mostly scarlet, black, chestnut, and Spanish oaks, pitch pine, red maple, sourwood, hickory, and tuliptree. The undergrowth includes mountain-laurel, bramble, and huckleberry bushes. This land type is too steep and stony either for cultivation or for pasture, though some of the smoother areas possibly could be used as pasture land, but the carrying capacity would be low.

SANDSTONE ROCKLAND

Bare exposures of sandstone bedrock are included in Sandstone rockland. A few stunted trees and a few bushes grow in crevices in the rock and on ledges where soil material has accumulated. Areas of this rockland are in Muskimgum stony loam, Muskimgum stony very fine sandy loam, and Rough stony land (Muskimgum soil material.)

SEQUATCHIE SERIES

The soil of the Sequatchie series has formed on stream terraces, in association with soils of the Holston series on the terraces and soils of the Pope series in first bottoms. It has developed from alluvium, consisting of sand, silt, and clay derived from uplands underlain by
noncalcareous sandstone and shale and in places by limestone. The soil has a fair supply of organic matter and is acid.

The surface layer is brown friable soil about 10 inches thick. The subsoil consists of light-brown or yellowish-brown friable fine sandy clay or very fine sandy clay 24 to 28 inches thick. Beneath the subsoil the material consists of brown friable crumbly fine sandy clay containing small dark-brown and ocheros-yellow spots and, in places, small black mineral particles. At a depth of 35 to 45 inches water-worn sandstone fragments underlie the soil profile in many places. Sequatchie fine sandy loam is mapped.

**Sequatchie fine sandy loam.**—This is a brown friable soil developed on low terraces from alluvial material washed from uplands underlain by noncalcareous sandstone and shale and in places by limestone. It is the most extensive soil derived from alluvial material in the county and lies well above overflow in most places. Owing to its favorable qualities it is very desirable for crops and pasture (pl. 5,C). The slopes occupied are nearly level to about 5 percent. External drainage is very slow to slow and internal drainage medium. Areas of this soil are near the Clinch River, the North Fork Clinch River, and the North Fork Holston River and near some of the smaller streams.

The surface layer is brown friable fine sandy loam 8 to 12 inches thick. The subsoil consists of light-brown friable fine sandy clay or very fine sandy clay, which at a depth of 32 to 35 inches passes into mingled or mottled brown, rust-brown, and light-gray friable fine or very fine sandy clay.

Included with this soil as mapped are a few small areas of Elk loam, near Copper Creek about 1 mile south of Nickelsville and near Moccasin Creek about one-fourth mile south of New Hope Church. The surface layer of this soil is brown or dark-brown friable loam 10 to 12 inches thick, and the subsoil is brown or light-brown friable silty clay or silty clay loam to a depth of 32 to 35 inches, where it gives way to brown or mottled brown and light-gray friable silty loam. The alluvial material from which this soil is derived was washed from uplands underlain mainly by limestone.

**Use and management.**—It is easy to till Sequatchie fine sandy loam and to conserve both its soil material and its plant nutrients. The moisture relations are good for tillage operations and plant growth. The soil contains a fair quantity of organic matter, is strongly to medium acid, and is moderately high in productivity. Almost all of it is used for crops, mainly corn, wheat, and hay, with a small total acreage in oats, barley, and tobacco.

With the management commonly practiced, including fertilization, corn averages about 50 bushels an acre; wheat, 15 bushels; timothy and clover mixed, 1 3/4 tons of hay; and lespedeza, 1 ton of hay. Under common management oats average about 37 bushels an acre; barley, 32 bushels; and tobacco, 1,500 pounds.

**STONY ALLUVIUM (POPE SOIL MATERIAL)**

Stony alluvium (Pope soil material) is composed of alluvial and colluvial materials derived from uplands underlain mainly by noncalcareous sandstone and shale. The relief is nearly level to sloping,
the slopes ranging to 8 percent. External drainage is slow to very slow and internal drainage medium to rapid. This land type is found along Straight Fork, Stony Creek, Chimney Rock Fork, and the Clinch River and on islands in that river.

The soil consists of brown or light-brown friable fine sandy loam or loam intermixed with many light-gray and light-brown angular and subangular sandstone fragments 4 to 10 inches across. Very little change in color and texture is noticeable to a depth of 36 inches or more, except that in some places below a depth of 6 to 8 inches the texture is slightly heavier. Many sandstone fragments 4 to 10 inches across are strewn over the surface of the land.

Use and management.—Stony alluvium (Pope soil material) is easy to conserve but, on account of the presence of rock fragments, is very difficult to till. It is moderately low in productivity. A large part of the total area is used for corn and pasture. Willow and sycamore trees grow near the streams in some places. Generally, corn averages about 20 bushels an acre; and under the management commonly practiced for pasture, about 5 acres of the land will graze one head of cattle.

**TEAS SERIES**

The soils of the Teas series are on valley uplands, where they are associated with those of the Dandridge and Westmoreland series. They are purplish-brown or purplish-red and are derived from weathered material of a purplish-red shale formation containing thin layers of limestone at wide intervals. A small quantity of organic matter is in the surface layer. The soils are acid.

The surface soil consists of purplish-brown or grayish-brown friable, fine-textured soil 5 or 6 inches thick. The subsoil is purplish-brown, dark purplish-brown, or purplish-red friable to fairly heavy silty clay loam or silty clay containing some small soft decomposed shale fragments. The subsoil ranges from 9 to 15 inches thick, though in some places very little or none is present. The material beneath the subsoil consists of purplish-red or purplish-brown friable silty clay, in places streaked ocherous yellow. Purplish-brown soft weathered shale fragments and brown weathered sandstone fragments are mixed with this material, and in places there is black mineral film. Shale bedrock generally underlies the soil at 28 to 35 inches, but in many places at much less depth.

Teas silt loam and its very steep phase are mapped. In addition, Teas soils are mapped in the Teas-Dandridge complex as the eroded and very steep phases of Teas-Dandridge silt loams, and in the Teas-Litz complex as the eroded, eroded steep, and very steep phases of Teas-Litz silt loams.

**Teas silt loam.**—This purplish-red soil developed in valley uplands from residual material of a purplish-red shale formation containing thin layers of sandstone and limestone at wide intervals. Its relief nearly everywhere is steep (slopes 30 to 60 percent) but in a few places hilly (15 to 30 percent). External drainage is rapid to very rapid and internal drainage medium. Areas are found near New Hurlin School, Glenwood School, Sunbright, and along Dry Creek northeast of Duffield.
The surface layer, about 6 inches thick, consists of purplish-brown friable silt loam. The subsoil is of purplish-brown, dark purplish-brown, or purplish-red moderately friable silty clay loam. At a depth of about 18 inches the subsoil passes into mingled purplish-brown, ochrous-yellow, and light-gray friable silty clay loam mixed with soft decomposed shale. In some places where little or no subsoil is evident the decomposed rock material lies at a depth of 6 to 8 inches. A few thin dark-green and yellowish-brown shale particles are on the surface and mixed through the soil, and in many places a few flat purplish-red sandstone fragments 4 to 10 inches across are on the surface.

*Use and management.*—About 75 percent of the total area of Teas silt loam is in forest, mainly of black and Spanish oaks, beech, red maple, tuliptree, hickory, ironwood, and black locust. This soil is difficult to till and to conserve. It is fairly low in organic matter, very strongly to medium acid, and of moderately low productivity.

A large part of the cleared land is used for pasture, and a small part for corn and wheat. Under management commonly practiced for pasture, about 6 acres are required to graze one head of cattle.

With common management, including the use of fairly low quantities of fertilizer, corn averages about 20 bushels an acre and wheat about 11 bushels.

**Teas silt loam, very steep phase.**—Although associated with the normal phase of the type and having essentially the same characteristics, this very steep phase differs in having much steeper slopes (60 percent or considerably more). External drainage is very rapid and internal drainage medium.

*Use and management.*—Practically all of Teas silt loam, very steep phase, is in forest, of about the same trees as are on the normal phase. Because of rapid runoff cleared soil is subject to severe erosion unless protected. Tillage is very difficult. The soil is fairly low in organic matter and has a fairly low water-holding capacity. It is moderately low in productivity. The management for crop and pasture use is difficult, though some slopes could possibly be used for pasture. The soil, however, can be best used for forest in most places.

**Teas-Dandridge silt loams, eroded phases.**—This complex of eroded phases consists of a purplish-red soil and a yellowish-brown soil so intrinsically associated in development that it is not practicable to separate them on the soil map. The purplish-red soil is Teas silt loam, which occupies about 75 percent of the complex; the yellowish-brown soil is Dandridge silt loam, which occurs in narrow strips and spots in the complex. The soils of this complex are steep in most places (slopes 30 to 60 percent) and hilly in others (15 to 30 percent). External drainage is rapid to very rapid and internal drainage medium. This complex is found in the southern part of the county, mainly near Shadylawn School, New Hurlin School, Boozy Creek, and Timbertree Branch. Practically all of it is cleared land.

The Teas soil in uneroded or slightly eroded areas has a purplish-brown or grayish-brown friable silt loam surface layer about 6 inches thick. Its subsoil consists of dark purplish-brown or purplish-red friable silty clay loam or silty clay to a depth of about 20 inches,
where it passes into mingled purplish-brown and gray friable silty clay loam mixed with soft decomposed purplish-red shale. In many places the subsoil is thinner and in some places a subsoil has not formed.

In uneroded or slightly eroded areas the surface layer of the Dandridge silt loam is grayish-brown or light-brown friable silt loam 5 or 6 inches thick. The subsoil consists of yellowish-brown or light-brown friable silty clay loam or silty clay. At a depth of 14 to 18 inches the subsoil gives way to mingled yellowish-brown, brown, and gray silty clay loam mixed with yellowish-brown soft weathered shale. In some places very little subsoil is evident; in others the surface layer is underlain directly by soft weathered shale.

In the eroded areas, 25 to 75 percent of the surface layer has been removed by accelerated erosion, and in many places only a thin layer of purplish-brown and light-brown silt loam remains. In plowed areas subsoil material is mixed with this silt loam, causing the texture to be somewhat heavier. In some places all the surface layer has been washed off, and the purplish-red and yellowish-brown subsoil is exposed.

Small purplish-brown and greenish-yellow shale particles are on the surface and in the soil in many places, and purplish-brown and light-gray flat sandstones 4 to 12 inches across are on the surface here and there. In some small areas on ridge tops the soils of the surface layer consists of grayish-brown or yellowish-brown fine sandy loam.

Use and management.—About 50 percent of the cleared land of Teas-Dandridge silt loams, eroded phases, is used for crops, mainly corn and wheat. A small total acreage is used for hay, tobacco, and oats. The remaining cleared land is lying idle, though some of it is used for pasture. Tillage is difficult on this complex, and the soil material and the plant nutrients are hard to maintain. The productivity of the soils is moderately low.

Under common management, including fertilization, corn averages about 20 bushels an acre; wheat, 11 bushels; and tobacco, 800 pounds. The hay crops are timothy and clover mixed and lespedea, and the yields of hay are fair. Oats give relatively low yields. Under common management 5 or 6 acres of pasture are required to graze one head of cattle, but under good management about 4 acres are required.

Owing to the poor workability and conservability of these eroded phases, their best use is for pasture.

**Teas-Dandridge silt loams, very steep phases.**—Areas of Teas silt loam and Dandridge silt loam in which the slopes are 60 percent or more are included in the complex of very steep phases. These soils are so intricately associated that it is not feasible to separate them on the soil map. The Teas soil predominates in this complex, the Dandridge soil occurring in narrow strips and in spots. This complex occurs in the southern part of the county associated with Teas-Dandridge silt loams, eroded phases.

The surface layer of the Teas soil ranges in thickness from 3 to 6 inches and consists of purplish-brown friable silt loam. The subsoil is purplish-red friable silty clay or silty clay loam. It is underlain at a depth of 8 to 12 inches by purplish-red soft decomposed shale. The surface layer of the Dandridge soil is grayish-brown friable silt
loam 3 to 6 inches thick. The subsoil is yellowish-brown friable silty clay loam to a depth of 8 to 10 inches, where it is underlain by yellowish-brown soft weathered material. In some places no subsoil is present in the soils of this complex, and in others weathered shale outcrops.

Use and management.—Practically the entire area of Teas-Dandridge silt loams, very steep phases, is in forest, mainly of Spanish and black oaks, beech, red maple, tuliptree, hickory, ironwood, and black locust. Tillage and conservation are very difficult, and productivity is moderately low to low. Forest seems to be the best use.

Teas-Litz silt loams, eroded steep phases.—The purplish-red soil of Teas silt loam and the light-brown soil of Litz silt loam are so intricately associated in this complex that their separation on the soil map is not feasible. The Teas soil comprises approximately 75 percent of the complex. Probably 90 percent of the total area is cleared, eroded land. The soils are derived from weathered material of a shale formation containing a small proportion of sandstone and limestone. This complex occupies steep relief (slopes 30 to 60 percent) and is widely distributed, having small to fairly large areas in all but the eastern parts of the county.

In uneroded or only slightly eroded areas the surface layer of the purplish-red soil is 5 or 6 inches thick and consists of purplish-brown friable silt loam. The subsoil is purplish-brown to purplish-red friable somewhat heavy silty clay or silty clay loam to a depth of 12 to 20 inches, where it passes into purplish-brown and purplish-red friable silty clay loam mixed with purplish-red soft decomposed shale. In some places the decomposed shale is much nearer the surface layer and very little subsoil has developed. Thin purplish-brown and greenish-yellow shale particles are scattered over the surface and mixed through the soil, and in places fragments of purplish-brown sandstone 8 to 10 inches across are on the surface.

The light-brown soil appears in this complex as spots or in strips a few feet to about 100 feet wide. In uneroded or only slightly eroded areas the surface layer is light-brown or light grayish-brown friable silt loam 5 or 6 inches thick. The subsoil consists of light-brown or yellowish-brown friable silty clay or silty clay loam. At a depth of 12 to 18 inches the subsoil passes into yellowish-brown and greenish-yellow soft weathered shale containing a small quantity of light-brown or brown friable crumbly silty clay loam. In some places very little subsoil is present; in others no subsoil has formed and the surface layer passes directly into soft shale. Here and there small light-brown and brown shale chips are on the surface and in the surface soil and subsoil.

Over most of the total area of this complex, erosion has been active and has removed 25 to 75 percent of the surface layer, in some places all of it, laying bare purplish-red and purplish-brown subsoil. Shallow to comparatively deep gullies have formed.

Use and management.—Tillage operations on Teas-Litz silt loams, eroded steep phases, are rather difficult. Owing to very rapid external drainage, the material of the soils and the plant nutrients are very hard to maintain. The content of organic matter is low, the moisture-holding capacity fairly low, and the productivity moderately low.
Steep slopes, ease of erosion, and difficulty of controlling runoff make this complex unsuitable in most places for cultivation. A very small part is used for corn and wheat, which under common management produce low yields. Pasture seems to be the best use, and nearly all the cleared land is so used. The pasture plants are generally poor, and broomsedge is common in most pastures. Under the common management 5 to 6 acres of this complex are needed to graze one head of cattle; under the better practices about 4 acres.

In most areas pasture plants thrive best on north and east slopes, largely because climatic and other conditions are more favorable for them there. Pastures on some areas would be improved if partly shaded with black walnut and black locust trees.

**Teas-Litz silt loams, eroded phases.**—Smother areas than those of the complex of eroded steep phases are included in this complex of eroded phases. The profiles of the soils of each complex and their condition of erosion are essentially the same. The separation is made on the soil map mainly because of the smoother relief of the eroded phases. Although the use suitability of the two complexes is the same, a large total acreage of the eroded phases is used for crops rather than pasture. In this complex the slopes range from 15 to 30 percent, but included with it are a few rolling areas with slopes of 8 to 15 percent. External drainage is medium to very rapid and internal drainage medium. This complex occurs in widely scattered areas associated with other complexes of Teas-Litz soils.

**Use and management.**—Most of Teas-Litz silt loams, eroded phases, is used for crops, mainly corn and lespedeza, with a small part in wheat and pasture. Tillage and the conservation of soil material and plant nutrients are difficult in most areas. The soils are low in organic matter, have a moderately low water-holding capacity, and are of moderately low to low fertility.

Under common management, including light applications of fertilizer, corn averages about 15 bushels an acre; wheat, 10 bushels; and lespedeza, 3/4 ton of hay. Under the management commonly practiced for pasture, about 5 acres are required to graze one head of cattle.

Although this complex of eroded phases is considered better suited physically for pasture than for crops, its productivity for crops can be increased by growing corn, wheat, and hay in 3- and 4-year rotations and by proper applications of manure and complete fertilizers.

**Teas-Litz silt loams, very steep phases.**—This complex consists of areas of very steep phases of Teas and Litz silt loams. These areas are so intricately associated that it is not feasible to separate them on the soil map. They comprise the most extensive complex of Teas-Litz soils in the county. Small to comparatively large areas are in all parts of the county except the eastern part.

The soil of this complex is derived from residual material of a mixed-rock formation, consisting of purplish-red shale, some light-brown shale, and thin widely spaced layers of sandstone and limestone. This formation has a northeast-southwest strike and extends in hilly belts across the northern and southern parts of the county. As the soils are closely related to the rocks, their mixed-color pattern coincides closely with the mixed color of the rocks that gave rise to them.
The very steep phase of Teas silt loam comprises about 75 percent of the complex. Its surface layer consists of purplish-brown or grayish-brown friable silt loam 5 or 6 inches thick. The subsoil is purplish-brown or purplish-red friable silty clay loam or silty clay to a depth of 10 to 15 inches, where it gives way to soft decomposed purplish-red shale. In some places the surface layer is underlain directly by decomposed shale.

In the very steep phase of Litz silt loam the surface layer is a light-brown friable silt loam 5 or 6 inches thick. The subsoil is light-brown or yellowish-brown friable silty clay loam or silty clay, which passes at 10 to 12 inches into yellowish-brown soft weathered shale. In some places where no subsoil is present the surface layer lies on the soft decomposed shale.

In many places small thin purplish-brown and yellowish-brown shale fragments are on the surface and in the soils of this complex, and in some places purplish-brown sandstone fragments, 8 to 10 inches across, are on the surface.

Use and management.—About 95 percent of Teas-Litz silt loams, very steep phases, is in forest, principally of black and Spanish oaks, beech, red maple, tuliptree, hickory, and black locust. The small total area of cleared land is used for pasture, but the yields are low. The slopes are too steep and the soils too shallow for cultivation. Pasture is not feasible, and even where superphosphate has been applied, the stand of pasture is too thin to prevent serious erosion.

TELlico SERIES

The soils of the Tellico series are on valley uplands associated with soils of the Carbo series and Rolling stony land (limestone material). They are derived from residual material of weathered calcareous sandstone. This sandstone, when leached of carbonate, leaves brown, reddish-brown, or purplish-brown soft sandstone, from which the soils are formed. The unweathered rock is gray, dark gray, or grayish purple and has the appearance of limestone. The soils are acid.

The surface layer is purplish-brown or brown fine-textured friable soil 5 to 6 inches thick. The subsoil is friable crumbly heavy loam, very fine sandy loam, or very fine sandy clay about 20 inches thick. The material beneath the subsoil consists of light to dark purplish-brown friable very fine sandy loam or very fine sandy clay mixed with brown, yellowish-brown, reddish-brown, and ochreous-yellow friable crumbly sandstone. At a depth of 36 to 48 inches this material passes into soft purplish-brown and rust-brown weathered bedrock. Bedrock proper lies at a variable depth below this weathered rock. The eroded and steep phases of Tellico very fine sandy loam are mapped.

Tellico very fine sandy loam, eroded phase.—Residual material of weathered grayish-purple calcareous sandstone gave rise to this soil. It is called red-sand land by some farmers. The relief is hilly (slopes 15 to 30 percent), though in some places it is rolling (8 to 15 percent). External drainage is medium to rapid and internal drainage medium. This eroded phase occurs in the southeastern part of the county associated with Carbo soil.

In uneroded areas the surface layer is 5 or 6 inches thick and consists of brown or purplish-brown friable very fine sandy loam. The
soil, however, has been moderately eroded in most areas and has lost 25 to 75 percent of the surface layer. In many places subsoil material is mixed with the plowed layers and gives it a slightly heavier texture than elsewhere.

The subsoil consists of purplish-brown friable crumbly heavy loam or friable very fine sandy clay. At a depth of about 24 inches it passes into purplish-brown friable mellow very fine sandy clay mixed with yellowish-brown, reddish-brown, and ochreous-yellow soft crumbly decomposed sandstone retaining its original structure lines. In places a very shallow subsoil is present; in others the subsoil is lacking and the surface layer passes directly into the decomposed sandstone layer. A few brown sandstone fragments, 1/2 to 6 inches across, are on the surface and in the surface soil, and a few small soft sandstone fragments are in the subsoil in places.

Use and management.—Practically all of Tellico very fine sandy loam, eroded phase, is cleared land used largely for crops. It can be tilled fairly easily but is rather difficult to conserve unless protected by vegetation and proper tillage. It is low in organic matter and moderate to rather low in productivity.

Corn, wheat, and hay are the principal crops. Potatoes are grown in small patches on some farms for home use. Some areas are used for pasture.

Black locust and black walnut, occurring here and there in pastures, are the principal trees. Small native vegetation in old fields and pastures includes broomsedge, hawkweed, wild carrot, plantain, dewberry, ironweed, sheep sorrel, yarrow, and mullein.

Under common management, including the use of fertilizer, corn yields average about 32 bushels an acre; wheat, 13 bushels; timothy and clover mixed and lespedeza alone, 1 ton of hay; and potatoes, 90 bushels. Under the management commonly practiced for pasture, about 4 acres will graze one head of cattle.

Strip cropping, contour tillage, and the use of close-growing crops are the main practices needed in controlling erosion on this soil. Proper fertilization is important in the production of crops and pasture.

Tellico very fine sandy loam, steep phase.—In uneroded areas this steep phase is similar in color, texture, and structure to uneroded soil of the Tellico very fine sandy loam, eroded phase, and differs mainly in having slightly thinner layers. Most of this steep phase, however, has been used for corn and other crops and through crop use has lost in some areas 25 to 75 percent of the surface layer by accelerated erosion. Slopes are 30 to 60 percent. External drainage is very rapid and internal drainage medium. This steep phase occurs in the southeastern part of the county near Muddy Gap.

Use and management.—Nearly all of Tellico very fine sandy loam, steep phase, is in permanent pasture, in which are a few black locust and black walnut trees. A small total acreage is used for corn, but the yields generally are somewhat lower than on the eroded phase of the type.

Tillage operations are difficult, and soil material and plant nutrients are hard to conserve. The soil is low in organic matter and moderately low in productivity.
Most of the permanent pastures have not been limed, fertilized, or otherwise properly managed, and the pasture is fairly poor. Very few pastures are clipped, and in those not clipped undesirable grasses and weeds predominate and give the pastures a relatively low carrying capacity.

The control of runoff on this steep phase is important for the conservation not only of soil material and plant nutrients but also of moisture for plant growth. Except for the growing of forest on this soil, the establishing of a good grass sod is the best method for controlling runoff and maintaining the supply of moisture. Proper grazing and light applications of lime and phosphatic fertilizer will help much in establishing a good sod and increasing soil productivity. A few pastures on this soil have been greatly improved by the use of 200 to 400 pounds an acre of triple superphosphate.

**Tumbez Series**

Soil of the Tumbez series is associated on valley uplands with soils of the Frederick, Elliber, and Carbo series. It is comparatively shallow, being underlain at 8 to 15 inches by the parent material, which is grayish-white and in places grayish-purple decomposed limestone. In many places the soil is calcareous throughout and increasingly so in the lower part. A fair quantity of organic matter is in the surface layer.

The surface layer is dark-gray or grayish-brown heavy silty clay loam or silty clay 3 to 5 inches thick. The subsoil consists of dark-gray or grayish-brown heavy plastic silty clay 5 to 12 inches thick. It grades into gray, dark-gray, or light grayish-brown heavy silty clay or clay, intermixed with almost white or grayish-purple soft decomposed fragments of platy limestone. In some places no subsoil is present, and the surface layer rests on soft decomposed limestone. Tumbez silty clay loam is mapped.

**Tumbez silty clay loam.**—This gray heavy-textured soil with a plastic subsoil occurs in relatively small scattered areas on valley uplands. It is calcareous throughout and in this respect differs from the other soils of the uplands. The surface relief is dominantly hilly (slopes of 17 to 35 percent), though in a few places slopes are stronger, and a milder relief (8 to 17 percent) prevails in a few areas. External drainage is medium to rapid and internal drainage slow. Areas of this silty clay loam are in Rye Cove and also northeast of Ewing Chapel, in the vicinity of Manville School, near Hickory Hill Church, and northeast of the junction of Grassy Creek and Copper Creek.

The 3- to 5-inch surface layer consists of dark-gray or grayish-brown heavy silty clay loam or silty clay, which when dry forms into small hard angular particles. The subsoil is dark-gray heavy plastic silty clay that can be easily broken into lumps ¼ to 1 inch in diameter. At a depth of 10 to 15 inches the subsoil passes into gray heavy silty clay mixed with soft decomposed limestone fragments. At 14 to 24 inches this material is underlain by gray, purple, and grayish-blue limestone. When wet, the surface soil is almost black.

**Use and management.**—Practically all of Tumbez silty clay loam has been cleared, mainly for corn and wheat, though a small part is used for tobacco and a small part for pasture. Owing to rather strong
slopes and heavy texture, the soil is moderately difficult to till. When planted to intertilled crops, it is fairly easily eroded.

With the management commonly practiced, including the use of fertilizer, corn yields average about 45 bushels an acre; wheat, 18 bushels; and tobacco, 1,400 pounds. Under common management for pasture, about 2 acres of this soil supply grazing for one head of cattle.

Although the smoother areas are well suited to corn, they are especially well suited to clover and alfalfa, which grow well where only light applications of fertilizer are made. Bluegrass and white clover predominate in the permanent pasture and grow as well without fertilization as on associated soils that have been fertilized and limed.

As this soil seems to be best suited to alfalfa, clover, and bluegrass, it can be improved more readily by adjusting the use to these crops than by other methods.

WAYNESBORO SERIES

The soils of the Waynesboro series have developed on high terraces near streams from old alluvium composed of sand, silt, clay, and sandstone fragments derived from uplands underlain mainly by noncalcareous sedimentary rocks. They are considerably leached, fairly low in content of organic matter, and acid.

The surface layer is about 8 inches thick and consists of light grayish-brown or light yellowish-brown friable sandy-textured soil. The subsoil has an upper layer of brownish-yellow, yellowish-brown, or reddish-yellow friable heavy fine sandy loam, light-textured fine sandy clay, or silty clay loam 4 to 10 inches thick and a lower layer of reddish-brown friable fine sandy clay or silty clay loam 18 to 24 inches thick. The subsoil is underlain by reddish-brown friable fine sandy clay or silty clay loam containing faint mottings of yellow and brownish red. Some water-worn rocks are on the surface and in the profile in many places. The sloping and hill phases of Waynesboro fine sandy loam are mapped.

Waynesboro fine sandy loam, sloping phase.—The light-colored and light-textured soil of this sloping phase has developed on stream terraces from old alluvial materials derived from uplands underlain mainly by noncalcareous sandstone and shale. The slopes are 8 to 15 percent. External drainage is medium and internal drainage medium to rapid. The areas of this soil are mainly along the Clinch River and the North Fork Holston River.

The 7- to 9-inch surface layer consists of light grayish-brown or light yellowish-brown friable loose fine sandy loam. In the upper part, the subsoil is brownish-yellow, yellowish-brown, or reddish-yellow friable heavy-textured fine sandy loam, light-textured fine sandy clay, or friable silty clay loam. Below a depth of 11 to 19 inches is reddish-brown friable fine sandy clay or silty clay loam that at 28 to 42 inches gives way to reddish-brown friable fine sandy clay, faintly mottled with yellow and brownish red. A few water-worn rock fragments 2 to 5 inches across are on the surface and in the soil.

Use and management.—As the surface layer of Waynesboro fine sandy loam, sloping phase, is friable sandy loam and the slopes moderate, tillage operations are relatively easy. The soil material and plant nutrients can be fairly easily conserved, though sheet and gully
erosion are active in places. The soil is fairly low in content of organic matter, very strongly acid, and of medium productivity.

Practically all of this sloping phase is cleared and mainly in crops, chiefly corn, wheat, hay, and tobacco. Under common management, corn averages about 35 bushels an acre; wheat, 10 bushels; timothy and clover mixed, 1\(\frac{1}{2}\) tons of hay; lespedeza, \(\frac{3}{4}\) ton of hay; and tobacco, 950 pounds.

**Waynesboro fine sandy loam, hill phase.**—In color, texture, and structure this phase is similar to the sloping phase of the type, but the soil layers are somewhat thinner in some places and the relief steeper (slopes of 15 to 30 percent). External drainage is rapid and internal drainage medium to rapid. This hill phase is more difficult to till and to conserve than the sloping phase. It occurs along the Clinch River, the North Fork Holston River, and Stony Creek.

**Use and management.**—Nearly all of Waynesboro fine sandy loam, hill phase, has been cleared and is mainly used for corn, wheat, hay, and tobacco. Under common management, corn yields average about 30 bushels an acre; wheat, 8 bushels; timothy and clover mixed, 1 ton of hay; lespedeza, \(\frac{3}{4}\) ton of hay; and tobacco, 850 pounds.

**WELLSTON SERIES**

The soils of the Wellston series occupy positions on strongly sloping and hilly ridges in mountainous country and are derived mainly from residual material of weathered sandstone. They are associated with soils of the Muskingum series but nearly everywhere are on milder slopes. They are low in organic-matter content and in natural fertility and are acid.

The surface layer, about 7 inches thick, consists of light yellowish-brown or light-brown friable soil. The subsoil is light-brown or yellowish-brown friable heavy loam or fine sandy clay about 20 inches thick. The material beneath the subsoil is a brownish-yellow friable crumbly weathered sandstone, containing sandstone fragments in some places. Wellston loam, hilly phase, is mapped.

**Wellston loam, hilly phase.**—Associated in places with Muskingum loam, this brown friable soil is, in general, deeper to bedrock and has a somewhat better developed profile. It is derived from weathered material, mainly of noncalcareous sandstone. The slopes range from 15 to 30 percent. External drainage is rapid and internal drainage medium. This soil is in the northern part of the county southeast and southwest of Brushy Knob.

The first inch or two of the surface layer consists of grayish-brown friable loam, containing organic matter derived mainly from the decay of leaves and twigs. The surface soil deeper is a light yellowish-brown or light-brown friable loam 4 to 6 inches thick. The subsoil is light-brown or yellowish-brown friable heavy loam or friable fine sandy clay to a depth of about 28 inches, where it passes into mingled yellowish-brown, dark reddish-brown, and light-gray friable crumbly fine sandy clay or heavy fine sandy loam mixed with partly decomposed sandstone fragments 4 to 8 inches across.

**Use and management.**—Nearly all of Wellston loam, hilly phase, is cut-over forest land. The trees are scarlet, black, and white oaks, red maple, hickory, tuliptree, sourwood, pitch pine, yellow and black
birches, and hemlock. The undergrowth includes mountain-laurel, bramble, and huckleberry.

This hilly phase is rather difficult to work and to conserve and is moderately low in productivity. Some areas near the Wise County line would produce fair pasture if cleared and properly managed. Under common management, about 6 acres would be required to graze one head of cattle, and under the better practices of management about 5 acres.

If cleared and cropped the soil would be seriously eroded unless proper precautions were taken to control erosion. Under common management the crop yields would be low—about 15 bushels of corn, 8 bushels of wheat, $\frac{1}{2}$ ton of timothy and clover hay, $\frac{3}{4}$ ton of lespedeza hay, or 800 pounds of tobacco an acre; under better practices they would be somewhat higher.

**WESTMORELAND SERIES**

In the valley uplands the soils of the Westmoreland series occur in hilly, knobby, and choppy areas, and on the mountain slopes in places where the slopes are dissected by many deep drainageways. They overlie decomposed rock of a formation consisting of alternate beds of varying proportions of limestone (about 40 percent) and shale (60 percent). The soils are associated with soils of the Lehew, Carbo, and Dunmore series. They vary considerably in depth because of the hilly and steep surface relief, but in general they are shallower than soils developed on smoother relief from the residuum of limestone. Their reaction is acid.

The surface layer consists of brown, light-brown, or grayish-brown fine-textured soil 3 to 6 inches thick, and contains a fair quantity of organic matter. The subsoil is light yellowish-brown, brown, or faintly reddish-brown friable silty clay or somewhat heavy silty clay 6 to 18 inches thick, though in places very little or no subsoil has formed. A few small black mineral particles and a few small soft shale fragments are in the subsoil in spots. Beneath the subsoil the material is mingled brown, ocherous-yellow, dark reddish-brown, and light-gray friable crumbly silty clay loam mixed with yellowish-brown, dark-green, and greenish-yellow soft decomposed shale that still retains its original structure lines. The shale contains small black mineral particles and black mineral film in some places. At a depth of 28 to 35 inches this material rests on limestone and shale.

Westmoreland silt loam and its rolling and very steep phases and the eroded and eroded very steep phases of Westmoreland silty clay loam are mapped.

In areas where Westmoreland soils dominate, the farmers grow small patches, mainly of corn and tobacco, on the steep slopes because of the scarcity of smooth upland (pl. 9, B). After a few years these patches are abandoned to native vegetation, and others are tilled. Under this system these steep soils are deteriorating.

**Westmoreland silt loam.**—Weathered material of a rock formation consisting of interstratified limestone and shale gave rise to this soil, which occupies positions on very hilly areas in the valley uplands. The relief is steep (30 to 60 percent), though in a few places it is hilly (15 to 30 percent). External drainage is rapid to very rapid and internal drainage medium. This silt loam occupies areas on the
north slopes of Copper Ridge, Moccasin Ridge, Big Ridge, Newman Ridge, and Purchase Ridge, and in the southern part of the county south of the North Fork Holston River.

The surface layer is 3 to 6 inches thick and consists of grayish-brown friable silt loam, light gray or light grayish brown when dry. In forests and in some pastures the surface layer to a depth of one-fourth to one-half an inch is dark grayish brown and apparently contains a fair quantity of organic matter.

The subsoil, where present, consists of light yellowish-brown or faintly reddish-brown friable silty clay loam containing a few soft smooth greenish-yellow and brown shale particles. At a depth of 12 to 18 inches it is underlain by soft decomposed dark-green and light-brown shale mixed with light-brown and slightly reddish-brown friable silty clay loam material. This soft shale retains its original structure lines and has black mineral film on the cleavage planes in places. In some places a subsoil has not formed and the surface layer lies on soft decomposed shale or partly weathered interbedded limestone and shale.

Use and management.—A small total acreage of Westmoreland silt loam is in forest, which includes white oak, black locust, black walnut, buckeye, and redcedar. The soil is difficult to cultivate and to conserve because of its steepness, shallowness, and erodibility. In the past a large part of the total area was cropped, and accelerated erosion resulted (pl. 10, B). Reclaiming the rough gullied land is a long process requiring proper reforestation. The soil is low in content of organic matter, has a fairly low water-holding capacity, and is of medium productivity.

The cleared land is used mostly for pasture, and a small total acreage is used for corn, which averages about 12 bushels an acre. It is fairly good pasture land, and under common management about 3 acres afford grazing for one head of cattle.

Westmoreland silt loam, rolling phase.—Similar to the normal phase of the type in physical characteristics, this soil differs mainly in having gentler slopes (8 to 15 percent). It is associated with other Westmoreland soils in the southern part of the county and generally occupies positions on the tops of hills. Both external and internal drainage are medium.

Use and management.—Practically all of Westmoreland silt loam, rolling phase, has been cleared of forest and is used mainly as cropland, with a small total acreage in pasture. The crops are chiefly corn, wheat, and hay.

Under common management, corn averages about 20 bushels an acre; wheat, about 10 bushels; timothy and clover mixed, about 1½ tons of hay; and lespedeza, about 1 ton of hay. Under the management commonly practiced for pasture, about 3 acres afford grazing for one head of cattle.

Tillage is rather easy in most places, and the soil can be fairly easily conserved. It holds moisture fairly well and is moderately high in productivity.

Management practices considered good for maintaining this soil, improving fertility, and increasing productivity include the growing of legumes more often in the rotation, contour cultivation, heavy fertilization, and turning under legumes.
Westmoreland silt loam, very steep phase.—The physical characteristics of this soil resemble those of the normal phase of the type, but the slopes, with gradients of 60 percent or considerably more, are steeper. It is associated with areas of the normal phase of the type.

Use and management.—Probably 85 percent of the total area of Westmoreland silt loam, very steep phase, is forested with trees of about the same kinds as those on the normal phase. Areas cleared of forest are used as pasture land, with yields relatively low. Because of steepness, this phase is subject to severe erosion when cleared of forest. Too steep for feasible cultivation or pasture, its best use is for forest.

Westmoreland silty clay loam, eroded phase.—Areas of Westmoreland silty clay loam from which probably two-thirds of the surface soil has been removed by accelerated erosion are included in this phase. The soil has formed from weathered material of a rock formation consisting of alternate beds of limestone and shale in about equal proportions. The soil is steep, the slopes ranging from 30 to 60 percent. External drainage is very rapid and internal drainage medium. Most of the areas are on the north slope of Clinch Mountain throughout its extent in the county. Other areas are northeast of Hortons Summit.

In areas unaltered or only slightly altered by erosion, the surface layer is light-brown or brown silty clay loam 5 or 6 inches thick. In the eroded areas, what little surface soil remains consists of light-brown, yellowish-brown, or slightly reddish-brown silty clay loam.

The subsoil, in many places exposed, is made up of brown or yellowish-brown rather heavy silty clay containing many light-brown thin shale particles. At a depth of 18 to 24 inches it passes into mingled yellowish-brown, greenish-yellow, rust-brown, and light-gray friable silty clay loam material intermixed with soft decomposed yellowish-brown shale. Black mineral film appears in places on the cleavage planes of the soft shale. In some places very little or no subsoil is present.

A few limestone outcrops are in the soil, and in many places light-gray flat angular limestone fragments 4 to 8 inches across are on the surface.

Use and management.—A large part of the total area of Westmoreland silty clay loam, eroded phase, is used for crops, mainly corn; the rest as pasture land. The cropland has been poorly managed, and as a result soil material and plant nutrients have been lost through accelerated erosion and the moisture-holding capacity of the soil has been lowered. Some of the erosion has been caused by dragging saw logs down slopes—a method still practiced in some localities. Erosion has been retarded in some places with check dams and in others with brush fastened to the ground, but in many areas no attempt has been made to control it.

Under common management for pasture, about 3 acres of this soil supply grazing for one head of cattle. Bluegrass, timothy, and orchard grass are the principal pasture plants, and broomsedge and poverty oatgrass grow in some places. Black locusts, found here and there in some pastures, are practically the only trees remaining on this soil.
Westmoreland silt loam, eroded very steep phase.—Having slopes of 60 percent or more, this phase comprises the steepest areas of the eroded phase of the type and is associated with areas of that phase. Very little of the soil has ever been cleared for agricultural use and its eroded condition is due to normal erosion, rather than to accelerated erosion brought about by wrong use and management. In normal erosion the surface soil is carried away almost as fast as it forms, and on the very steep slopes only a relatively thin surface remains. Throughout the rest of the soil, the profile is similar to that of the eroded phase of the type, except that its depth to bedrock is generally shallower.

A few small areas have been cleared for pasture land, but the yields generally are low. As the soil is not suited to crops and pasture its best use is for forest.

USE, MANAGEMENT, AND PRODUCTIVITY

The soils are grouped into land classes and their use, management, and productivity are here discussed, together with their use suitability, to show their interrelations more clearly. A soil is managed for a particular use, and its productivity is affected by use and management and by other factors. The classification of the soils is based on similarity in general suitability for crops, pasture, or forest and on management requirements.

The estimated crop yields for each soil on which important crops are grown and productivity ratings for the important crops are given in tables 10 and 11, respectively. The crop yields and productivity ratings are based on three levels of management.

LAND CLASSIFICATION

The 109 soil units mapped (soil types, phases, complexes, and miscellaneous land types) are classified on the basis of physical characteristics that can be observed in the field. The method of classification into taxonomic units is described in the section on soil survey methods and definitions. Certain characteristics, as color, may be considered internal; others, as slope, external. Both internal and external characteristics may be significant in determining the physical suitability of a soil unit for use. In order to set forth better their relation to agriculture, the soils are grouped in five numbered classes on the basis of decreasing relative physical suitability for crops requiring tillage. Although the soils of no one class are ideal for the existing agriculture, the First-class soils more nearly approach the ideal than the Second-class soils. Likewise, the soil of each succeeding class is further from the ideal than that of the preceding class. Three conditions—productivity, workability, and conservability—determine the suitability of a soil for agricultural use.

Productivity refers to the ability of the soil to produce crops under prevailing farm practices. A soil may be productive of a crop but not well suited to it because of poor workability, conservability, or both.

Workability refers to ease of tillage, harvesting, and other field operations. Texture, structure, consistence, organic-matter content, moisture conditions, stoniness, and slope are important among the qualities that affect workability.
Conservability refers to requirements for maintaining or improving productivity and workability. The degree to which the soil responds to management practices varies with the conservation requirements.

An ideal soil for agriculture is one that readily produces a large number of important crops and is easily worked and conserved. All the soils fall short of this ideal, but they differ widely in the degree of shortcoming. Moreover, in degree of departure from the ideal, any one of the three conditions may greatly differ from the other two. For example, a soil may be highly productive and easily conserved but very difficult to work. The productivity, workability, and conservability of each soil is given in Table 11. The land classification indicated in that table is an estimate of the results of the combined effects of these three factors on the suitability of the soil for crops requiring tillage.

The soils are placed in these five classes on the basis of information obtained through the experience of farmers, soil surveyors, extension workers, experiment station personnel, and others who work with the soil. For example, a farmer knows that some soils on his farm are more desirable for certain uses than others. By such comparisons within farms and among farms the soils can be ranked according to suitability for different uses under present conditions. Where information based on experience is lacking, one soil can be ranked by comparisons with others of similar characteristics for which information is available.

**FIRST-CLASS SOILS**

The First-class soils are good to excellent for both crops and pasture. They differ in degree of profile development, character of parent material, color, structure, and in other respects but are relatively similar in their general physical suitability for agriculture. Compared with other soils of the county, all are fairly well supplied with plant nutrients; but for some crops even the most fertile is responsive to additions of needed amendments. They contain more lime (available calcium) than most of the other soils. Except Burgin silty clay loam, which has slow internal drainage, all are well drained; yet their physical properties are such that they retain moisture well, thereby tending to insure an even and adequate supply for plant growth. Good tilth is easily maintained, and the range of moisture conditions for tillage is comparatively wide. They are well supplied with organic matter, and their physical properties favor normal circulation of air and moisture. Roots freely penetrate all parts of the subsoil.

None of these soils is characterized by any prominently adverse soil condition. All are nearly free of stones and have relief favorable to soil conservation and tillage. None is severely eroded or highly erodible.

The soils of this class are relatively high in productivity, are easily tilled, and offer no serious problem of conservation of soil fertility and soil material under the common system of farming. All are well suited to most of the exacting and intensive crops of the locality when grown under the prevailing systems of management.

The First-class soils of the county in the descending order of desirability are as follows:

<table>
<thead>
<tr>
<th>Emory silt loam</th>
<th>Burgin silty clay loam</th>
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<tbody>
<tr>
<td>Pisgah silt loam</td>
<td>Hagerstown silt loam, rolling phase</td>
</tr>
<tr>
<td>Hayter loam</td>
<td>Hagerstown silty clay loam, eroded phase</td>
</tr>
</tbody>
</table>

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SECOND-CLASS SOILS

The Second-class soils are fair to good for crops and fair to very good for pasture. They include soils with an even greater diversity of physical characteristics than those in the First-class. They are relatively similar in physical suitability for agriculture but within a limited range may differ in productivity, workability, or conservability. Each soil is moderately deficient in one or more of these qualities, and the detrimental effect of the deficiencies upon the physical suitability of the soil for agriculture is greater than in any of the First-class soils and less than in any of the Third class.

In general, the soils of this class are moderately productive of most crops commonly grown. Their physical properties are at least moderately favorable for tillage, maintenance of good tilth, and normal circulation and retention of moisture. Except the Hagerstown, Tumbez, and Allen soils, none occupies very strong relief. None is extremely stony or severely eroded. In short, each soil is moderately deficient in one or more desirable characteristics but none so seriously as to make it poorly suited to use for agriculture under the prevailing systems of management.

The Second-class soils in the descending order of desirability are the following:

Pope silt loam
Tumbez silt loam
Sequatchie fine sandy loam
Greendale silt loam
Hayter fine sandy loam
Camp silt loam
Pope fine sandy loam
Carbo silt loam, rolling phase
Greendale silt loam, sloping phase
Camp silt loam, sloping phase

Bolton loam, rolling phase
Lodi cherty loam
Frederick cherty silt loam
Elliber cherty silt loam
Lindside silt loam
Leadvale silt loam
Hagerstown silt loam, hilly phase
Hagerstown silty clay loam, eroded hilly phase
Allen fine sandy loam

THIRD-CLASS SOILS

The Third-class soils are poor to fair for crops and poor to good for pasture. One or a combination of the features that contribute to workability, productivity, and conservability, is sufficiently adverse in each of these soils to limit definitely the physical suitability of the soil for the production of the common tilled crops under prevailing farming practices, but none is so limiting as to render the soil definitely unsuited physically to tilled crops. In these soils, one or more of the following undesirable features is prominent: Poverty of plant nutrients; poverty of organic matter; undesirable texture, structure, or consistence; strong slopes; chertiness; and inadequate natural drainage.

These soils are low in suitability for crops that require tillage, but cover a wide range of suitability for permanent pasture.

The Third-class soils in the descending order of desirability for agriculture are the following:

Bolton loam
Carbo silt loam
Carbo silty clay loam
Carbo very fine sandy loam
Holston fine sandy loam
Waynesboro fine sandy loam, sloping phase
Leadvale silt loam, sloping phase

Jefferson fine sandy loam
Philo fine sandy loam
Monongahela fine sandy loam
Lodi cherty loam, hilly phase
Hayter fine sandy loam, hill phase
Westmoreland silt loam, rolling phase
Frederick cherty silt loam, hilly phase
FOURTH-CLASS SOILS

The Fourth-class soils are poor for crops and fair to very good for pasture. Each is so difficult to work or to conserve, or both, that cultivation generally is not feasible; but each is sufficiently fertile and has sufficiently good moisture relations to maintain at least a moderate cover of pasture plants.

In general these soils are best suited to use as pasture land under the prevailing farm practices. They are generally used for pasture in areas where an adequate supply of fair to good cropland is available. A considerable acreage of some of the soils is used for crops, chiefly on farms where acreage of soils better suited to the production of crops is too small to meet the needs of the farm unit.

The Fourth-class soils in decreasing order of desirability for agriculture are:

| Melvin silt loam               | Dandridge silt loam, eroded hilly phase |
| Hagerstown stony silt loam    | Hayter stony fine sandy loam, hill phase |
| Hagerstown silt loam, steep phase | Lodl cherty loam, steep phase             |
| Hagerstown stony silt loam, steep phase | Dunmore silty clay loam, eroded steep phase |
| Alluvial soils, undifferentiated | Teas-Litz silt loams, eroded phases       |
| Carbo stony silty clay loam, rolling phase | Chilhowie stony clay, severely eroded phase |
| Wellston loam, hilly phase     | Dandridge silt loam, eroded phases        |
| Westmoreland silt loam        | Teas silt loam                            |
| Westmoreland silty clay loam, eroded phase | Stony alluvium (Pope soil material)       |
| Hayter stony fine sandy loam   | Jefferson stony fine sandy loam           |
| Carbo stony silty clay loam    | Clarksville cherty silt loam, steep phase  |
| Carbo silt loam, steep phase   | Chilhowie stony clay, severely eroded steep phase |
| Carbo very fine sandy loam, steep phase | Teas-Dandridge silt loams, eroded phases  |
| Frederick-Elliber stony silt loams | Teas-Litz silt loams, eroded steep phases |
| Bolton loam, steep phase       | Dekalb loam                               |
| Frederick-Elliber stony silt loams, steep phases | Jefferson stony fine sandy loam, hill phase |
| Frederick cherty silt loam, steep phase | Clarksville cherty loam, hilly phase     |
| Rolling stony land (limestone material) | Atkins fine sandy loam                    |
| Elliber cherty silt loam, steep phase | Tellico very fine sandy loam, steep phase |
| Atkins fine sandy loam         |                                           |
| Tellico very fine sandy loam, steep phase |                                           |

FIFTH-CLASS SOILS

The Fifth-class soils are very poorly suited both to cultivated crops and to pasture under prevailing conditions. Each is so difficult to work or conserve or so unproductive that cultivation is not generally feasible in the prevailing system of farming; and each is so low in plant nutrients or has such poor moisture relations, or both, that common pasture plants make very little feed. Even though forest trees grow more slowly on many of these soils than on soils of the other four classes, the Fifth-class soils are better suited physically to forest than to crops or pasture. Existing conditions either of the locality or of the farm unit, however, may require the use of some of these soils for pasture or crops despite the fact that in natural condition they are poorly suited to these uses.
Each soil of this class is characterized by one or more of the following undesirable features: Hilly, steep, or very steep relief; high content of loose rock fragments; many outcrops of bedrock; low content of plant nutrients; and excessive drainage. As a result of these unfavorable features, the productivity both for tilled-crop and pasture plants is generally low, and tillage with common farm implements either is impossible or very difficult. Many of these soils can be cultivated only with hand implements. If used for crops, the soils of this class require careful management for their conservation.

The Fifth-class soils, in the approximate order of descending usefulness for agriculture, are:

Westmoreland silt loam, very steep phase
Westmoreland silty clay loam, eroded very steep phase
Bolton loam, very steep phase
Bolton loam, eroded steep phase
Lodi cherty loam, eroded steep phase
Lodi cherty loam, very steep phase
Elliber cherty silt loam, very steep phase
Rough stony land (limestone material)
Montevallo shaly silt loam, hilly phase
Dandridge silt loam, very steep phase
Muskimgum loam
Muskimgum very fine sandy loam
Teas silt loam, very steep phase
Teas-Dandridge silt loams, very steep phases
Teas-Litz silt loams, very steep phases
Litz shaly silt loam
Montevallo shaly silt loam
Muskimgum stony loam
Muskimgum stony very fine sandy loam
Lehew stony very fine sandy loam
Rough gullied land (limestone and shale materials)
Rough stony land (Muskimgum soil material)
Riverwash
Limestone rockland
Sandstone rockland

LAND USE AND SOIL MANAGEMENT

The farmer who attempts to readjust the use and management of his soils is confronted with a number of problems. Among the factors giving rise to these problems are size and type of farm; physical character of the land, including the pattern of soils; prevailing social and economic conditions, as transportation, market, church, and school facilities; immediate demands for a cash income for taxes, indebtedness, support of family, and other expenses; relations between prices of farm products and other commodities; facilities and resources for operating purposes, including buildings, equipment, seed, kind and number of livestock, cash, credit, and other items; the operator's ability, preferences, and other characteristics; community cooperation with respect to drainage, water disposal, marketing, buying, and other operations; farm tenure; labor conditions; and health.

The farmer as an individual has full or partial control over some of these factors but little or none over others. A full solution of his problem may require community, State, or national action. The farmer as an individual can make only the adjustments toward better soil management that are possible within his financial and personal ability. In the management suggested for the various soils it is recognized that certain practices may not be feasible for some farmers in their present circumstances; but it is assumed that those suggested are feasible for the majority of the farms under present conditions. Many farmers may attain the same results by the use of different combinations of management practices better suited to their particular conditions than those here indicated. New developments or changes in fertilizer analysis and management practices may bring about
needed revision in the following management practices that are recommended.

In the following pages some of the principles of good soil management and the major requirements of the soils are briefly explained. Practices that will aid in the application of principles of good management on groups of soils having relatively similar requirements are discussed.

The term "land use" refers to broad uses, as for (1) crops that require tillage, (2) permanent pasture, and (3) forests. The term "soil management" refers to such practices as (1) choice and rotation of crops; (2) application of lime, commercial fertilizer, manure, crop residues, and other soil amendments; (3) proper tillage; and (4) control of water on the land by engineering operations.

**PRESENT MANAGEMENT AND MANAGEMENT REQUIREMENTS OF SOILS**

The management of soils is discussed for the most intensive general use to which they are considered at least fairly well suited physically, although they may also be well suited to a less intensive use. For example, all soils that are well suited to crops are also well suited to pasture or to forest. On many farms it is expedient to put soils to a less intensive use like pasture, even though they may be well suited to crops. On the other hand, some farmers may have to use soils for purposes to which they are not well suited.

In the discussion of the management of soils that are considered well suited to crop plants, the requirements of the soils are discussed from the viewpoint of the needs of all crops of the rotation, not of individual crops. In the type of farming followed by most farmers the requirements of the rotation are considered above those of the individual crop. For instance, fertilizer and lime are applied to effect the greatest yield from the rotation as a whole, not necessarily to get the greatest yield from the crop to which it is applied.

All soils that are considered at least fairly well suited physically to crops (First-, Second-, and Third-class soils) are divided into 10 groups, on the basis of management requirements for those that require tillage, and are classified for convenience in groups A–1 to A–10; the soils that are physically poorly suited to crops but well suited to pasture (Fourth-class soils) are divided into 8 groups, B–1 to B–8; and each group is discussed with respect to fertilizer, lime, and other requirements for pasture. The soils that are considered best suited physically to forest (Fifth-class soils) constitute the single group C–1.

**GROUPS OF SOILS WELL SUITTED PHYSICALLY TO CROPS REQUIRING TILLAGE**

Those soils well suited to tilled crops are placed in 10 groups, each group lettered A. Good practices of management, including choice and rotation of crops, fertilization, tillage, and measures for the control of water on the land are suggested for each group. Management practices for the production of permanent pasture also are suggested.

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The five soils of group A—1 (Burgin silty clay loam; Emory silt loam; Hagerstown silt loam, rolling phase; Hayter loam; and Pisgah silt loam) have similar slopes, ranging from nearly level to about 15 percent. They have a brown to dark grayish-brown fairly deep to deep surface soil, high organic-matter content, fairly high to high pH value, good water-holding capacity, and medium internal drainage except in Burgin silty clay loam, where it is slow. All except Hayter loam have a high clay content in the subsoil. They are relatively high in plant nutrients, are developed principally from limestone materials, and have deep profiles over bedrock. None is severely eroded or subject to severe erosion. All hold plant nutrients well and can easily be improved once they have deteriorated. They are relatively free from stones, though some small chert fragments are on Pisgah silt loam and some sandstone fragments on Hayter loam. A few outcrops of limestone are in Hagerstown silt loam, rolling phase.

The soils in this group, except the Burgin silty clay loam, have similar management requirements in respect to tillage, crop rotations, fertilization, and liming. Tillage is most difficult in Burgin silty clay loam, which has the heaviest texture, and least difficult in Hayter loam, which has the lightest texture. All the soils except Burgin silty clay loam can be cultivated under a comparatively wide range of moisture. Burgin silty clay loam can be cultivated under only a narrow range of moisture, and if it is cultivated under adverse moisture conditions, clods will be formed. As this soil is not so well drained as the others, crops, especially small grains, sometimes freeze. The Hayter loam is inherently less fertile than the other soils and perhaps requires heaviest fertilization and liming for most crops.

Present management.—The soils of group A—1 are used principally for field crops—mainly corn, small grains, and clover for hay. Most of them are best suited physically to corn and hay crops, though good yields of small grains can be expected on all except the depressed or low-lying areas of Emory silt loam, Burgin silty clay loam, and Hayter loam, on which small grains often lodge, especially in wet seasons. The Burgin and Hagerstown soils, owing chiefly to the heavy texture of their surface soil and subsoil, are physically poorly suited to cabbage, potatoes, and other vegetables, though the Hagerstown soil is well suited to tomatoes.

Legumes common to the county seem to do well on this group. Burley tobacco makes a large growth and is heavy but generally lacking in quality (brightness), especially on the Emory and Burgin soils. The soils of this group are probably better suited to alfalfa than any of the other soils in the county.

Three- and four-year crop rotations, including corn or tobacco, small grain, and clover, or clover and grass, are the most common rotations in use. Some farmers practice longer rotations of these crops, using the hay crops for pasture the fourth, fifth, and sixth years of the rotation. Amendments are applied the first and the second years on corn or tobacco and small-grain land. From 150 to 300 pounds an acre of 16- or 20-percent superphosphate, or 4–12–4, 0–10–4, or 0–12–5 fertilizer, or the equivalent, are used for corn and
small grain, and 400 to 800 pounds of 3-8-5, 3-8-3, or 3-10-6 for tobacco. Some farmers apply 20-percent superphosphate and 10 to 20 wagonloads (tons) of manure and some top dress with 50 to 150 pounds of muriate of potash. When clover or lespedeza is sown during fall, a few farmers top-dress small grain in the rotation with the equivalent of 200 pounds of 20-percent superphosphate. Not much lime is used on these soils. A few farmers, however, apply the equivalent of 2 tons of ground limestone an acre every 4 to 6 years on land prepared either for small grain or corn. Wheat and other small grains sown in harvested tobacco patches generally are not fertilized. There is a tendency in recent years to use a slightly heavier application and more concentrated analysis of fertilizers.

The common tillage practices include fairly deep plowing, disking, harrowing, and some rolling. Most plowing is done in February and March. That early plowing is very important on the Hagerstown and Burgin soils is realized by most farmers. Little regard for contour tillage is evident, and most fields are square or rectangular. Very few cornfields are planted in the hill or checkrowed. Shallow cultivation is the practice on most farms. A few farmers cultivate corn deeply once or twice. The weeds are chopped out of most cornfields and some soil is dragged to the corn rows. The corn stubble generally is disked or harrowed in preparation for the small-grain seeded.

All the soils of this group are well drained except Burgin silty clay loam, on which small areas have been ditched in order to obtain good yields of most crops. The soils have very few if any sod-covered water channels, and no strip cropping has been observed. Only a small total acreage is in permanent pasture; and except for close grazing, and in a few pastures the clipping of undesirable herbage, very little attention is given pasture management.

Management requirements.—All the A-1 soils are well suited physically to crops and are considered the best in the county for most of the common crops. They are easy to work, easy to conserve, and highly productive of most crops. They are unusually well suited for corn and hay, especially legumes. High organic-matter content, relatively high moisture content, and depressed or low relief lessen the suitability of some areas of the Burgin, Emory, and Hayter soils for small-grain crops. In many places, however, this condition can be overcome by heavier applications of fertilizer containing phosphorus and potash and by management that will reduce the high organic-matter content.

The soils of this group are suitable for short crop rotations, but the rotations depend not only on the soil, but also on many other factors of farming. Desirable rotations that will help much in conserving the soils are 2 to 6 years in length. The 2-year rotation includes corn, tobacco, or potatoes the first year, followed by wheat or some other small grain with lespedeza or red clover sown in it in spring and turned down the following spring for corn. The 3-year rotation consists of the following: First year, corn, tobacco, or potatoes; second year, small grain; and third year, red clover, or red clover, lespedeza, and timothy mixed. The 4-year rotation is the same as the 3-year except that grass is grown for hay the fourth year. A 3- to 6-year
rotation is as follows: First year, corn; second year, small grain; and third, fourth, or fifth year, alfalfa. The general fertilizer recommendation for crops grown in the suggested rotations includes the equivalent of 200 to 400 pounds of 20-percent superphosphate an acre each year of the rotation where no need for potash is evident and 200 to 400 pounds of 0-14-7 mixture each year where these deficiencies appear. If manure is used, potash can be omitted and 20-percent superphosphate applied. Most of the fertilizer should be applied to land for corn and small grain the first 2 years of the rotation, as the soils hold plant nutrients well. Heavy applications, especially of phosphatic fertilizer, distributed at one time should give as good results as frequent light applications. Of the soils of this group, Hayter loam is probably the most deficient in potash and other plant nutrients and for most crops probably should be the most heavily fertilized.

Land for alfalfa should be fertilized with 600 to 800 pounds an acre of 2-12-12 or 0-12-12 mixture, or the equivalent, and top-dressed each year with 400 to 800 pounds of a 0-12-12 mixture, or half the quantity of a 0-20-20 mixture. Applications of 15 to 20 pounds of borax followed by 15 pounds as a top dressing every year thereafter should increase alfalfa yields. If free of undesirable weed seeds, manure is an excellent top dressing for alfalfa. When 200 to 400 pounds of 20-percent superphosphate, or its equivalent, are mixed with 8 to 10 wagonloads of manure, excellent results should be obtained. Part of the initial fertilizer for alfalfa land should be turned under, and part applied when the land is seeded.

For truck crops and crops of high acre value, as potatoes, tobacco, and garden vegetables, applications of 600 to 1,000 pounds an acre of complete fertilizer are recommended except where 10 to 20 tons of manure are applied. Some of the complete fertilizers to use for these crops are 3-12-6, 4-12-4, 4-16-4, and 3-9-8.

These soils, being derived chiefly from limestone materials, rarely need lime for such crops as corn, small grains, and tobacco and but little for red clover. In places the soils have been used for these crops since cleared of forest and still range from strongly acid to neutral. Hayter loam is most acid and probably requires more lime than the other soils.

An application of 1 ton an acre of ground limestone, or its equivalent, for red clover and 2 to 4 tons for high lime-requiring crops, as alfalfa and sweetclover, every 3 to 6 years in the rotation should keep these soils in a desirable reaction. The soils become progressively higher in pH value in transition from the Hayter, Emory, Hagerstown, and Pisgah to the Burgin.

All the soils except Burgin silty clay loam are moderately easy to till. As that soil has a narrow moisture range for tillage and is fairly difficult to plow and keep from clodding, a good seedbed is difficult to prepare. Winter plowing is considered good for all these soils, and the plowing should be deep. Cultivation of growing crops should be shallow and as nearly along the contour as feasibly possible. Heavy farm machinery can be used with ease on these soils.

For the soils of this group contour cultivation, sodded drainage-ways, and the judicious use of close-growing crops are essential in each rotation for the conservation of soil material and water.
A small total acreage of these soils is used for permanent pasture. The soils are excellent for pasture and produce well where phosphatic-fertilizer application, close grazing, proper feeding on the land, and proper scattering of droppings are practiced. The equivalent of 200 to 300 pounds an acre of 20-percent superphosphate every 3 to 5 years should produce good pasture if other good management practices are followed. It may be necessary, however, to use complete fertilizers to get the best pasture on these soils.

GROUP A-2

Hagerstown silt loam, hilly phase, is the only soil included in group A-2. This soil differs from Hagerstown silt loam, rolling phase, in group A-1, mainly in being slightly shallower to bedrock and more eroded and in containing more outcrops of limestone.

Present management.—The present management for the soil of this group is similar to that for those of group A-1, but on some areas contour cultivation, strip cropping, and longer crop rotations are practiced.

Management requirements.—The management requirements of the soil in group A-2 differ from those suggested for group A-1 mainly in crop rotations, tillage practices, and the control of water on the land. The crop rotations should be longer or include only small-grain and hay crops. When row crops are not grown, 3- or 4-year rotations should be satisfactory; but when they are grown, 5- or 6-year rotations are needed. The fertilization should be slightly heavier than for group A-1 and should be practiced each year of the rotation. The fertilizers should be applied so as to produce good stands of leguminous sod crops and close-growing crops.

Less diskng and harrowing should be practiced then on group A-1, and tillage should be strictly along the contour. Special practices for the control of water on the land include strip cropping and sodding drainageways. Drainage furrows may be beneficial in some places.

Only a few permanent pastures are on the soil of group A-2, and these are on land that has been wrongly managed. For best production, these pastures require heavier applications of phosphatic fertilizer than pastures on soils of group A-1. In addition, they require all the other practices of good management. Where erosion is severe, manure is necessary for quickly establishing good pasture.

GROUP A-3

The seven soils of group A-3 (Bolton loam, rolling phase; the sloping phases of Camp and Greendale silt loams; Elliber and Frederick cherty silt loams; Hayter fine sandy loam; and Lodi cherty loam) have similar physical characteristics and consequently similar management requirements. They have formed from weathered material of dolomitic limestone, limestone containing some sandstone, or from colluvial material. They have similar slopes, the gradients generally ranging from 5 to 18 percent. All contain some chert, sandstone, or shale fragments; have relatively thick surface layers; and are comparatively deep to bedrock. They are well drained, have a loam or silt loam texture, are moderately well supplied with organic matter, and have similar lime requirements. Some of the soils are rather erosive, but none has been severely eroded. The vegetative cover is similar in most areas where the soils have been managed similarly.
All these soils are easy to till and conserve and are moderately productive of most of the common field crops. They are especially well suited physically to the production of small grains, burley tobacco, and vegetables but not so well suited to the production of corn and legumes as the soils of group A–1. Greendale silt loam, sloping phase, is probably the best soil in this group for hay.

Present management.—Group A–3 soils are managed in most respects like the soils of group A–1. Smaller acreages of legumes, especially clover and alfalfa, are grown and somewhat heavier applications of complete fertilizers are used for tobacco and for most of the field crops on some farms. These soils generally are not plowed for corn so early as the soils of group A–1, mainly because they are lighter textured, warm up earlier in spring, and unless cultivated immediately grow weeds and briars rapidly after they are plowed.

Management requirements.—Group A–3 soils are well suited physically to most crops grown in the county but are best suited to wheat, rye, and oats. Timothy, orchard grass, herd’s-grass, lespedeza, vegetables, and strawberries do well. Under the present management, alfalfa is difficult to grow and the stand thins out after being established. Red clover can be grown satisfactorily provided the soils are limed, but failures of that crop are frequent on unlimed soil.

Crop rotations may be the same as those suggested for the soils of group A–1. These are 3- and 4-year rotations and include corn, small grain, and a hay crop consisting of red clover, lespedeza, and timothy. These two rotations are considered the best, but longer or even shorter rotations can be used without losing much soil material and plant nutrients.

Soils of this group are generally deficient in phosphorus and potash and in lime, since the unlimed areas are strongly acid. Camp silt loam, sloping phase, and Greendale silt loam, sloping phase, are slightly less acid in most places than the other soils of the group. The general fertilizer recommendation for the common field crops is 300 to 400 pounds of 0–14–7, or 0–12–12 mixture an acre, or its equivalent, each year of the rotation; and recommended fertilizers for special crops, as potatoes and tobacco, are the same as given in group A–1, but the quantities should be slightly heavier. When a large quantity of manure is used 300 to 400 pounds an acre of 20-percent superphosphate should be sufficient. If nitrogen deficiency occurs and clover or some other leguminous crop is not turned under, corn, when about knee high, should be side-dressed with 150 pounds of nitrate of soda. Vegetables may be top-dressed with 200 pounds of 10–0–10 fertilizer. From 2 to 3 tons of ground limestone should be applied to the land every 4 to 6 years for small grains and clover, and twice this quantity for crops that require much lime. The Green- dale, Camp, and Lodi soils will probably show more response to fertilizer applications and other management than the other soils of this group.

All the soils are easy to till and are favorable for the use of heavy farm machinery. Deep plowing and shallow cultivation should be practiced and should be as nearly on the contour as possible. Early plowing is beneficial in the preparation of a good seedbed. These soils have such favorable physical properties that they can be plowed and prepared early in spring for seeding, or can be plowed and har-
rowed immediately before seeding. The Greendale, Hayter, and Lodi soils are perhaps the easiest to till.

No special practices are needed to control water on the land or to conserve soil material in most places. Strip cropping, however, should probably be practiced on some of the stronger slopes of the Bolton, Lodi, and Elliber soils in places where they adjoin steeper soils.

As the soils of group A–3 are fairly highly leached, have only fair water-holding capacity, are low in most plant nutrients, and naturally produce undesirable pasture, all phases of pasture management, except seeding, should be practiced. The soils generally sustain enough good grasses to seed the entire pasture if properly managed. From 1 to 2 tons an acre of ground limestone, or its equivalent, every 4 or 5 years should provide sufficient lime for grass growth. Between 300 and 400 pounds of 4–16–4, 0–12–12, or 0–14–7 fertilizer every 4 or 5 years should produce good results, provided all other pasture management is practiced.

GROUP A–4

The six soils of group A–4 (Camp, Greendale, Lindside, and Pope silt loams; and Pope and Sequatchie fine sandy loams) differ from those of group A–3 principally in having milder slopes (about 5 to 8 percent in gradient) and in being developed on colluvial slopes, stream terraces, or first bottoms. They have formed from colluvial or alluvial materials derived from uplands underlain mainly by dolomitic limestone, limestone and shale mixed, or noncalcareous shale and sandstone. These materials accumulated at the base of slopes, along streams, and in depressions. All the soils are moderately well supplied with organic matter and mineral plant nutrients. The organic-matter content, however, is slightly higher than that in the soils of group A–3.

The soils of group A–4 have similar management requirements and are physically suited to similar crops. All soils except Lindside silt loam are well drained. The Pope and Lindside soils are subject to overflow from the adjacent streams. Water sometimes stands on the Camp, Greendale, and Sequatchie soils in places.

These soils are best suited physically to corn, red clover, and alsike; to timothy, redtop, and other grasses; and to vegetables commonly grown. Sequatchie fine sandy loam also produces good yields of small grains and tobacco in some places, but the tobacco is generally a heavy grade. Alfalfa is grown on this soil, but the stand soon dies in most places. Generally the natural lime content of Lindside silt loam is high; in the other soils only moderately high to low. The Sequatchie and Pope soils, according to tests, show a high lime content in large areas along the Clinch River above Fort Blackmore.

Present management.—The soils of group A–4 are managed similarly to those of group A–3, but the crop rotations are shorter and the quantities of fertilizer used are smaller for the Lindside and Pope soils in some places. Corn generally is grown without the use of fertilizer, especially on Pope silt loam and Lindside silt loam. A considerable total acreage of the Lindside soil is in permanent pastures, which are seldom fertilized but are closely grazed in most places.

Management requirements.—The soils of group A–4 are as well suited physically to short crop rotations as those of any other group in the county, and 2-, 3-, and 4-year rotations that include the general
field crops are suggested. Less nitrogen should be used on these soils than on those of group A–3. Similar quantities, however, of phosphorus, potash, and lime, are required, although in most places Lindside silt loam needs very little lime for most of the crops grown.

Tillage with heavy machinery is much easier on these soils than on those of group A–3, and contour furrowing is needed less but should be practiced as much as feasible. No special practices are required for the control of water on the land, but Lindside silt loam would be benefited in places by ditch drainage.

Management requirements for pasture are similar to those for group A–3, which include fertilizing, liming, and the other practices of management except seeding.

**GROUP A–5**

The four soils of group A–5 (Dunmore and Hagerstown silty clay loams, eroded hilly phases; Carbo silty clay loam, rolling phase; and Hagerstown silty clay loam, eroded phase) are derived chiefly from material weathered from highly calcareous limestone. These soils have heavy-textured subsoils and are moderately to highly erosive. Owing to their eroded condition, they have a relatively narrow range of moisture conditions for tillage and are subject to clodding when plowed slightly wet or dry. They are stone-free except for a few bedrock outcrops. Their lime requirements are similar and they are suited to similar crops. All the soils of this group are fairly well suited to alfalfa under proper management.

**Present management.**—The present management practices of the soils of group A–5 are similar to those for the soils of group A–1 including similar crop rotations, fertilization, fairly deep plowing, and shallow cultivation. Some farmers plow these soils in February and March because of their rather heavy texture and narrow range of moisture for cultivation. The plowing is done early enough for the land to freeze and for the clods and soil to soften for the preparation of the seedbed.

**Management requirements.**—The soils of group A–5 are well suited to rotations that include the common field crops, and 3- to 5-year rotations are considered good. A 3-year rotation of corn, small grain, and clover, or a 4- or 5-year rotation of corn for 1 year, small grain for 1 year, and alfalfa for 2 or 3 years is excellent.

The soils of this group are moderately low in potash and generally low in phosphorus. When no manure is applied suitable fertilization for the general field crops includes 200 to 300 pounds an acre of 0–14–7 mixture each year of the rotation. Heavier applications of these fertilizers supplemented with manure should be applied to tobacco. For alfalfa, 600 to 800 pounds of 0–12–12, 0–14–7, or 3–18–9 mixture and 20 pounds of borax as an initial application, and 500 to 800 pounds of 0–12–12 mixture and 15 pounds of borax as a top dressing every year should give good results. If sufficient manure is used, the potash can be left out of the fertilizer.

The equivalent of 2,000 pounds an acre of ground limestone every 4 to 6 years should properly condition the acidity of these soils for clover and other field crops except alfalfa and sweetclover. Alfalfa
and sweetclover should receive an initial application of 2 to 4 tons of ground limestone, or its equivalent, depending on the soil reaction, half the application to be turned under and the other half put on the surface at seeding. The land should be top-dressed with 2 to 3 tons of ground limestone every 4 to 6 years.

The soils of this group need organic matter, which should best be supplied by farmyard manure or leguminous green manure. Organic matter would improve their moisture relations and tilth conditions and make plant nutrients more easily available. In addition to other benefits, crops with numerous large roots, as alfalfa and clovers, improve soil structure and aeration and in this respect are superior to lespedeza and other small-rooted crops. Improved aeration results in increased bacterial and chemical activity, which in turn makes the plant nutrients more readily available and increases the organic-matter content of the soils.

These soils have similar tillage requirements and are rather difficult to till. Owing chiefly to their heavy texture and to their tendency to clod, they should not be plowed when too wet or too dry. The heavy sticky soils increase the draft of the plow and make plowing difficult. The slope of the moldboard must be adjusted so as to cut a thinner slice than in the looser and less sticky soils. Early spring or late winter plowing and thorough diskng are needed in order to obtain a good physical condition for seedbeds. The preparation of seedbeds is difficult, because the shallow surface soil is mixed with the heavy-textured subsoil when plowed. Contour tillage should be practiced to conserve moisture and soil material.

In dry periods following extremely wet periods the surface of these soils bakes and frequently results in poor stands of small grains and clover. Grass and clover should be thoroughly seeded but not too deeply, and the crust that forms from soil drying should be harrowed until softened. Mulching eroded areas where possible with straw and manure should aid in establishing good stands of small grains and clover.

Management requirements for pastures on the soils of this group include (1) an application of 200 to 300 pounds an acre of 20-percent superphosphate, or the equivalent, every year, (2) feeding cattle on the land as much of the time as possible during winter, (3) close grazing, (4) little or no seeding except where the land is rather badly eroded, (5) clipping undesirable plants, and (6) scattering droppings over the land.

Locust and walnut trees grow well on these soils and have a desirable effect on pasture. They shade out undesirable grasses and weeds and desirable pasture grass grows under their shade. They also furnish excellent shade for cattle and help retard erosion.

GROUP A-6

Management group A-6 includes only Tumbez silty clay loam. It is a productive soil especially suited to alfalfa and permanent pasture because of its high content of lime.

Present management.—Practically all of Tumbez silty clay loam is cleared and used mainly for the production of corn and wheat, but small acreages are devoted to pasture and tobacco. For spring plant-
ing, many farmers plow the land early enough (February and March) for it to freeze. The clods of this heavy-textured soil are thereby softened, the seedbed improved, and the absorption and storage of moisture increased. In general, plowing 5 to 7 inches deep, shallow cultivation, and crop rotations are practiced, but the soil is seldom fertilized for corn or limed for clover. Little contour tillage is done.

Management requirements.—Because of heavy texture, narrow range of moisture content satisfactory for cultivation, and strong slopes, group A–6 soil is moderately difficult to till, and when planted to intertilled crops, it is fairly easily eroded. Early spring or late winter plowing and thorough diskng are needed in order to obtain a good seedbed condition. The slope of the moldboard should be adjusted to cut a thinner slice than is desirable in looser and less sticky soils. Contour tillage is necessary to reduce erosion and conserve moisture.

In dry periods following extremely wet periods the surface of this soil may become hardened or baked, a condition causing poor crop stands, especially of grass, clover, and small grains. To prevent this, seeding should be thorough but not deep; and where feasible the surface crust should be harrowed until softened. The mulching of eroded areas with straw and manure should aid in establishing good crop stands.

Because of the soil’s susceptibility to erosion and other difficulties of management, relatively long rotations are more suitable than shorter ones. A 4- or 5-year rotation, with corn 1 year, small grain 1 year, and alfalfa for 2 or 3 years, is more satisfactory for conserving this soil than rotations in which an intertilled crop is used more frequently.

For general field crops, 200 to 300 pounds an acre of 20-percent superphosphate appears to be suitable fertilization. For alfalfa, 600 to 800 pounds of 0–12–12, 0–14–7, or 3–18–9 mixture and 15 pounds of borax as an initial application, and 500 pounds of 0–12–12 mixture and 15 pounds of borax as a top dressing every year should give good results. If sufficient manure is used, the potash can be left out of the fertilizer. Tumbez silty clay loam seldom needs lime for the production of crops, but its acidity should be tested.

It is an excellent soil for pasture, and will produce without amendments as good stands of bluegrass and white clover as associated soils that have been fertilized and limed. Close grazing seems to be the only management required for obtaining good pasture. Some areas of pasture, however, show a need for some fertilization.

As this soil seems best suited to alfalfa, clover, and bluegrass, it can be improved more readily by adjusting its use to these crops than by other methods.

GROUP A–7

The three soils of group A–7 are Carbo silt loam, Carbo silty clay loam, and Westmoreland silt loam, rolling phase. The two Carbo soils differ from the Carbo soil in group A–5 mainly in having stronger slopes. They require management similar to that of the Carbo in that group, however, but should be strip-cropped where feasible. Furthermore, sod crops, small grain, and close-growing legumes should be included in the rotations more often than is the common practice. The Westmoreland soil is mostly on ridgetops in pasture-adapted areas, and
for best pasture requires management similar to that of the other soils of this group. It, however, is not very well suited physically to alfalfa, mainly because of shallowness to bedrock. Small grains do well, but corn is less well adapted than to the Carbo soils of this group.

GROUP A-8

Seven soils (Bolton loam; Carbo very fine sandy loam; Clarksville cherty silt loam; the hilly phases of Elliber and Frederick cherty silt loams; Lodi cherty loam, hilly phase; and Tellico very fine sandy loam, eroded phase) derived from weathered material of dolomitic limestone and sandstone mixed, clayey limestone, and calcareous sandstone are included in group A-8. They differ from the soils in group A-3 mainly in having steeper slopes (15 to 30 percent in most places).

Present management.—In nearly every respect the present management of soils of group A-8 is similar to that of soils in group A-3. A few farmers, however, plow on the contour with hillside plows, practice strip cropping, and use slightly longer rotations that include more hay crops and small-grain crops (pls. 9, 6 and 10, 6).

Management requirements.—Group A-8 soils are best suited physically to small grains and grasses and should be used for such crops as much as feasible. Longer crop rotations, 4 to 6 years, should be employed to conserve the soil. First year, corn or tobacco; second year, small grain; third and fourth years, clover and grass; and fifth and sixth years, grass. If strip cropping is practiced, 3- and 4-year rotations can be used. Small-grain and hay crops also are suggested for the shorter rotations. Slightly heavier applications of fertilizer, manure, and lime should be used than suggested for the soils of group A-3. These amendments should be applied each year of the rotation, as most of the plant nutrients and lime are rather rapidly leached from these soils.

Most of these hilly soils are unfavorable for the use of heavy farm machinery. They should be plowed fairly deeply, harrowed as little as possible, and thoroughly packed to prevent erosion and loss of rain water. Intermittent drainageways should be kept sodded, and all tillage operations should be on the contour. Eroded areas should be mulched with straw and manure. Strip cropping should be practiced to check runoff and reduce erosion.

The suggested pasture management is the same as for the soils of group A-3, but in harrowing pastures with heavy implements and in building lanes to waterways much care should be taken to prevent erosion. Such lanes should be zigzag rather than straight down the slopes, and the heavy machinery should follow the contour as nearly as possible. A few black locust and black walnut trees here and there in the pastures provide shade for cattle and seem to improve the pasture.

GROUP A-9

The four soils of group A-9 (Allen fine sandy loam and the hill phases of Hayter, Jefferson, and Waynesboro fine sandy loams) are derived from similar parent materials and have similar physical characteristics and management requirements. The Allen, Hayter, and Jefferson soils are developed over old colluvial beds consisting mainly of sandstone and shale materials. The Waynesboro soil is developed
from alluvial material of high terraces in places along the larger streams. These soils have slopes of 15 to 30 percent and have a fine sandy loam surface layer and a fine sandy clay subsoil. They are low in lime and other plant nutrients. All are moderately difficult to work and conserve and moderately low to moderately high in productivity. They are suited physically to similar crops.

Present management.—The group A-9 soils are used principally for the common field crops. They are better suited physically to small grains and grasses and to potatoes and other vegetables than to clover, alfalfa, and tobacco, though tobacco of good quality is grown where proper management is practiced.

Crop rotations lasting 4 to 6 years are practiced, as follows: First year, corn, tobacco, or potatoes; second year, small grain; third year, mixed-hay crops, chiefly lespedeza and timothy; fourth year, a hay crop; and fifth and sixth years, hay crops, consisting mostly of grasses.

Amendments used in the rotations consist chiefly of 4-12-4 or 0-10-4 fertilizer. The fertilizer is applied at the rate of 200 pounds an acre each year on land used for corn and small grain.

Before seeding grass and clover, some farmers apply the equivalent of 2 tons an acre of calcium carbonate to land prepared for small grain. A few farmers top-dress hay crops with superphosphate. Tobacco and other crops requiring much fertilizer receive 600 to 800 pounds of 3-8-3 or 3-8-5 mixture, or 10 to 20 tons of manure, supplemented either with 400 pounds of 20-percent superphosphate or with 200 to 400 pounds of 3-8-5 mixture. Little manure is used except for tobacco and garden vegetables. Permanent pastures generally are not fertilized or otherwise properly managed and are fair to very poor.

The soils of group A-9 generally are plowed fairly deep, mainly because they are easy to plow; the plowing usually is done early in spring, immediately before crops are planted. Contour tillage rarely is practiced. Cultipackers and land rollers are used by a few farmers either before or after clover and small grain are seeded. Level and shallow cultivation are practiced by most farmers. Two-foot walking cultivators are used in places for destroying briers and weeds and for cultivating cornland. Strip cropping is practiced by a few farmers for the control of water on the land.

Management requirements.—Group A-9 soils are suited physically to the common field crops but less so than soils of any of the groups already discussed. They are especially well suited to grasses, lespedeza, and small grains, chiefly because the light texture, low lime content, and loose open consistence permits moisture to soak in readily. Alfalfa and other crops with large root growth and high moisture, lime, and plant-nutrient requirements do not grow well or survive very long after becoming established.

Suggested crop rotations for the soils of this group range from 3 to 6 years in length. The 3-year rotation is as follows: First year, small grain; second and third years, mixed-hay crops. The 4-year rotation consists of the following: First year, tobacco or corn; second year, small grain; and third and fourth years, mixed-hay crops. The 5- and 6-year rotations are similar to the 4-year rotation, but the land is used for hay crops the fourth, fifth, and sixth years, during which it is fertilized fairly heavily.
Each rotation should include 2 to 3 tons of ground limestone an acre, or the equivalent, every 3 or 4 years, preferably before hay crops are seeded. From 400 to 600 pounds of 0–12–12 fertilizer or 300 to 400 pounds of 0–20–20 fertilizer, or equivalent, each year of the rotation should effect good crop yields, provided sod-forming legumes are turned under. If a leguminous crop is not turned under, 300 to 600 pounds of 3–12–6 fertilizer should produce good results. Potatoes and other vegetables should receive 1,000 to 1,500 pounds of 3–9–6, 3–10–6, or 4–12–8 fertilizer, or the equivalent. Mulching eroded areas with manure and straw is helpful in obtaining better crop yields. Nitrogen is especially needed by most of these soils, either as an ingredient of the fertilizer or as a side dressing. The fertilizer should be applied each year for most crops, so that it can be used by the plants before it is removed by leaching. Inoculation of red-clover seed is important, as it usually increases the yields.

The soils of group A–9 can be plowed even when their moisture content is relatively high or relatively low. Plowing early in spring for corn, tobacco, and potatoes is probably advisable because loose seedbeds are easy to prepare immediately after the land has been plowed. The plow draft is easy, but moving heavy farm machinery over these soils is difficult. Deep plowing should be practiced, but the cultivation of row crops should be shallow and level. Seedbeds should be firmed with a cultipacker and harrowed as little as possible.

Contour tillage, though difficult, is necessary for soil conservation and water control on the land. As much organic matter as possible should be turned under. The water channels should be sodded. For further control of water on the land strip cropping is suggested, using chiefly sod-forming or close-growing crops, as clover, grass, or small grain.

Pasture management should include heavy fertilization, liming, and other satisfactory pasture practices. For establishing good pastures, 2 tons an acre of ground limestone, 400 to 600 pounds of 4–12–12 or 4–16–4 fertilizer, or 6 to 10 tons of manure and 400 to 600 pounds of 20-percent superphosphate, or their equivalents, should be applied every 3 or 4 years. Pasture management should also include the clipping of undesirable herbage, proper feeding of cattle on the land, mulching and seeded eroded areas, close grazing, and scattering the droppings. Applications of 400 to 600 pounds of 20-percent superphosphate, or its equivalent, and 1 to 2 tons of ground limestone as a top dressing every 3 or 4 years should also give good results. If potash deficiency appears, 400 to 600 pounds of 0–14–7 fertilizer should be substituted for 20-percent superphosphate until corrected.

Pasturing farm wood lots is not a good practice unless the trees are locust or walnut because pasture under most other trees is of poor quality. Cattle lanes to watering places and routes for heavy farm machinery should follow the contour wherever possible. Pasture adjacent to woods should be seeded with shade-enduring plants, as Korean and sericea lespedezas.

GROUP A–10

Except Philo fine sandy loam and Monongahela fine sandy loam, which have imperfect drainage, the soils of group A–10 (Holston, Jefferson, Monongahela, and Philo fine sandy loams; Leadvale
silt loam and its sloping phase; and Waynesboro fine sandy loam, sloping phase) are well drained, have similarly colored surface layers, and differ very little in texture, consistence, and depth. All are developed either from colluvium or from alluvial materials derived mainly from uplands underlain by noncalcareous sandstone and shale. They are low in lime and other plant nutrients but easy to cultivate and conserve. They are suited physically to similar crops. Philo fine sandy loam is subject to overflow from the adjacent streams, and Monongahela fine sandy loam has flat places on which water sometimes stands. These conditions of slow internal drainage render these two soils poorly suited to tobacco, small grains, alfalfa, vegetables, and fruits. They are well suited, however, to corn and hay crops except in very wet seasons.

Present management.—The soils of group A–10, except the Philo and Monongahela, are managed like those of group A–9. These two soils, where used for crops, are ditched in most places; and a 2-year rotation of corn and hay is followed. Some farmers, however, use longer rotations, in which corn is grown 2 years in succession and hay 2 or 3 years. A larger acreage of soils of this group is bare of vegetation in winter than of soils of group A–9 and a larger acreage is used year after year for corn, even though under this practice the corn yields are relatively low.

Haphazard soil management is probably more common in the A–10 group than on most of the other soils of the county. Such management seems to be due to the fact that the A–10 soils are associated with poor soils suited physically only to forest. Furthermore, many of the farms on which they are located are near coal-mining districts, where farming is menager, and in districts where part-time farming is most common. Vegetables commonly grown in the county are especially well adapted to the soils of this group.

Management requirements.—Although group A–10 soils are low to very low in content of essential plant nutrients, humus, lime, and probably other constituents, they have many favorable qualities that make them suitable for crops and are fairly productive. All the soils of the group excluding Philo fine sandy loam and Monongahela fine sandy loam will grow almost any crop successfully except alfalfa.

Crop rotations suggested for soils of this group consist of 2-, 3-, and 4-year rotations. In the 2-year rotation corn is followed by small grain and lespedeza. The 3-year rotation is the following: First year, corn, tobacco, or potatoes; second year, small grain; and third year, clover. The 4-year rotation is similar to the 3-year rotation except that clover is grown in the fourth year. As the soils are especially well suited to vegetables, such crops as potatoes, beans, cabbage, onions, tomatoes, carrots, and kale can be grown in short rotations.

The amendments for the crop rotations are similar to those suggested for group A–9, but the soils retain plant nutrients better and show more response to management than soils of that group. The production of crops on the group A–10 soils depends more on the kinds of amendments applied and the way they are used than on other practices of management.

The soils of group A–10 have good tillage conditions, becoming more favorable in transition from Monongahela fine sandy loam; Leadville silt loam, sloping phase; Leadville silt loam; Jefferson fine
sandy loam; Waynesboro fine sandy loam, sloping phase; and Philo fine sandy loam to Holston fine sandy loam. They have a wide range of moisture for cultivation and can be plowed and cultivated easily with heavy farm machinery. Only the more sloping areas need to be cultivated along the contour. No special practices to control water on the land are necessary, except on the Monongahela and Philo soils, which can be improved for some crops by underdrainage.

The management requirements of pastures of group A–10 are similar to those of group A–9, but special practices for preventing the loss of soil and water are not necessary and a little less fertilization is needed.

GROUPS OF SOILS BEST SUITED PHYSICALLY TO PERMANENT PASTURE

The soils considered best suited physically to permanent pasture are placed in eight groups, each group bearing the prefix B. They are grouped on the basis of their management requirements, which for permanent pasture generally are fertilization, liming, regulated grazing, clipping of ungrazed herbage, and scattering feed and droppings.

GROUP B–1

The three soils of group B–1 (Alluvial soils, undifferentiated; Atkins fine sandy loam; and Melvin silt loam) are among the best in the county for pasture. They occupy low positions near streams, are nearly level to gently sloping, and have good water-holding capacity, since they retain moisture well in dry seasons. Except Atkins fine sandy loam, they have a relatively high content of organic matter and lime and doubtless have a rather high content of other plant nutrients. The Atkins soil generally is low in lime and other plant nutrients but responds well to good management. These soils support similar vegetation. All are easy to conserve, fairly easy to manage for pasture, and require similar practices of management.

Present management.—The B–1 soils are used almost solely for pasture. Management practices include close grazing and to a small extent fertilization, clipping of undesirable plants, feeding cattle on the land, and seeding.

Management requirements.—All the B–1 soils should produce good pasture when top-dressed with 300 to 400 pounds an acre of 4–16–4 fertilizer, or its equivalent. Close grazing, clipping of undesirable plants, and draining the wetter areas by ditches also are beneficial. In addition to these practices, pasture on Atkins fine sandy loam is benefited by applications of 1 ton to 2 tons an acre of ground limestone, or its equivalent.

GROUP B–2

Inherently productive of desirable pasture grasses, the six soils of group B–2 (Carbo stony silty clay loam, rolling phase; Frederick-Elliber stony silt loams; Hagerstown silt loam, steep phase; Hagerstown stony silt loam; Westmoreland silt loam; and Westmoreland silty clay loam, eroded phase) are especially well suited physically to permanent pasture. Mainly because of their steeper slopes and stoniness, however, they are not so well suited to this use as the B–1 soils. They are underlain by limestone, interstratified limestone and shale, or impure dolomitic limestone. All have a fine-textured surface soil and subsoil and are moderately high to high in lime, organic matter,
and other plant nutrients. Heavy farm machinery for spreading lime and fertilizer is difficult to move over most of the areas. Small patches of soil lying between rock outcrops in smoother areas of the stony soils are well suited physically to alfalfa, and a few may be used with difficulty for corn, small grains, and clover.

Present management.—A large part of the B–2 soils is cleared and used mostly for pasture. Small areas are under reestablished forest, and some small tracts are idle. A great part of Westmoreland silty clay loam, eroded phase, and a small part of Westmoreland silt loam are cropped chiefly to corn, and under this use these areas can be expected to deteriorate. Common pasture management consists of close grazing; little fertilization except on specially selected farms; and very little or no clipping of undesirable weeds and grasses, seeding, or feeding cattle on the land. Few if any droppings are scattered over the pasture.

Management requirements.—The pastures on B–2 soils should be top-dressed every 4 or 5 years with 300 to 600 pounds an acre of 20-percent superphosphate, or its equivalent. Of the soils in this group Frederick-Elliber stony silt loams may need the heaviest fertilization. Complete fertilizer, or manure and superphosphate, should be applied to eroded areas until grasses become well established. From 200 to 400 pounds of 4–16–4 fertilizer, or 10 tons of manure and 200 to 300 pounds of 20-percent superphosphate, or its equivalent, should be sufficient.

Little lime is needed except in run-down places. If it were feasible to feed cattle at the places where manure is most needed, the somewhat difficult practice of spreading the droppings would not be necessary. Under some conditions, however, the practice would be profitable.

Close grazing seems to have a more desirable effect on the pastures than undergrazing, but it should not be practiced continuously. Clipping ungrazed herbage is not necessary if close grazing and the proper feeding of cattle on the land are practiced.

The seeding of pastures is not necessary except in eroded places. Under proper management enough bluegrass and white clover are present to reseed thinly grown areas. Scattered locust and walnut trees are desirable in pastures on the steep slopes, as such trees are useful in preventing soil slips, especially in the Westmoreland soils.

Areas of group B–2 soils on south and west slopes generally absorb the least moisture, remain drier, and are more eroded than areas elsewhere. Here the practices of management should be in accordance with these conditions of slope.

GROUP B–3

The development of the three soils of group B–3 (Hayter and Jefferson stony fine sandy loams and Stony alluvium (Pope soil material)) took place over colluvial material at the foot of slopes and along drainageways. Sandstone boulders and smaller sandstone fragments on the surface and in the soils make them stony. The soils are fine sandy loam or loam in texture, have a relatively deep surface soil, and in most places are deep to the bedrock. They are moderately low in lime and other plant nutrients. Jefferson stony fine sandy loam probably is the least productive for pasture. External drainage ranges from very slow to medium and internal drainage from medium
to rapid. Where the stones are not too numerous on the surface, machinery for spreading lime, fertilizer, and manure can be used.

Present management.—A large part of the B-3 soils is cleared, but chiefly because of their stony nature only a few small tracts are cultivated. Corn is the chief crop grown. A great part of the acreage is used for pasture. Except on farms especially selected for demonstration purposes, fertilization and liming are practiced to only a limited extent on pasture land. In general, close grazing is practiced but overgrazing is not common. There is little clipping of undesirable plants, no definite system of feeding cattle on the land, and very little scattering of droppings.

Management requirements.—Fertilization of pastures on Hayter stony fine sandy loam should be similar to that on the soils in group B-2. The other soils should produce good pasture if top-dressed every 3 or 4 years with 400 to 600 pounds an acre of 20-percent superphosphate and other management is properly practiced. In places where the pastures are poor and the soil is deficient in potash, an application of 400 to 600 pounds of 4-16-4 or 0-14-7 fertilizer, or the equivalent, every 3 or 4 years may be required to establish a stand of grass. When the carrying capacity has been increased with desirable grasses, 400 to 600 pounds of 20-percent superphosphate should easily maintain the pasture.

All the soils are between very strongly and medium acid. One to two tons of ground limestone an acre, or its equivalent, every 3 or 4 years should keep the reaction favorable for pasture. Hayter stony fine sandy loam should receive lighter applications, as it is somewhat less acid than the others.

Close grazing, clipping undesirable plants, seeding the eroded spots, proper feeding of cattle on the land, and scattering the droppings are important pasture-management practices on these soils.

GROUP B-4

The two soils of group B-4 (Elliber and Frederick cherty silt loams, steep phases) are derived from products of weathered impure dolomitic limestones, have steep slopes, and are only moderately well supplied with lime and plant nutrients. They have a cherty silt loam surface soil and a cherty silty clay loam or silty clay subsoil. They are deep to the limestone bedrock, though there are a few limestone outcrops. External drainage is rapid to very rapid and internal drainage medium. Plant nutrients, however, are leached from the soils rather rapidly.

These soils require similar management for pasture. Where proper management has not been practiced, the herbage in the pastures consists mainly of broomsedge, dewberry, smilax, cinquefoil, poverty oatgrass, plantain, aster, ragweed, hawkweed, wild carrot, sumac, wild strawberry, and some bluegrass, crabgrass, and white clover. There generally is enough bluegrass and white clover to reseed the pastures fairly rapidly under proper fertilization and other good management practices. A general view of the pastures from a distance shows chiefly broomsedge fields and an occasional area of greener, shorter, more desirable grasses.

Present management.—Probably 80 percent of the acreage of the soils of group B-4 has been cleared, and as most of this has been
cropped at some time it has been depleted of much of its fertility. The limited acreage now cropped is used chiefly for corn in an irregular rotation. Only a few of the pastures are clipped, properly grazed, fertilized and limed, and have cattle fed on them during the winter.

Management requirements.—Until pastures on group B–4 soils are well established and their carrying capacity has increased to the extent that droppings and legumes will furnish enough manure to supplement the nitrogen and potash content of the soils, 1 to 1½ tons of ground limestone an acre, or its equivalent, should be applied every 3 or 4 years. From 300 to 400 pounds of 3–12–6 fertilizer every 3 or 4 years is suggested for a top dressing. When the pastures have become well established, 400 to 600 pounds of 20-percent superphosphate, or its equivalent, every 4 or 5 years should give good results. Where 10 tons of manure are applied, 400 pounds of 20-percent superphosphate should be sufficient for a good stand of grass. If a deficiency in potash occurs, 400 pounds of 0–14–7 or 0–12–12 fertilizer should be applied instead of the 20-percent superphosphate.

Close grazing but not overgrazing helps to establish good pastures rapidly on these soils. Seeding is needed only on eroded areas. Clipping undesirable plants in the pastures, feeding cattle on the land, and scattering the droppings are beneficial. When heavy farm machinery is moved across the pastures, care should be taken to move it as nearly as possible along the contour. Cattle lanes to watering places and feeding barns should be properly placed to avoid erosion. On south and west slopes the soil has a lower moisture content and pastures are more difficult to establish than on soils with east and north slopes. The pastures generally are best on the areas having the most favorable moisture relations. Mulching with straw and manure is necessary in some places in order to establish pasture quickly.

Locust and walnut trees are not so much needed on these soils as on soils where the runoff is very swift, but such trees are beneficial in some places, especially in the eroded areas. Flowing is difficult, but it is not needed in seeding, as the good grasses on the land are sufficient to reseed the pastures, provided good management is practiced.

The less steep areas are fairly well suited physically to permanent meadow, and orchard grass, timothy, lespedeza, and tall oatgrass grow well on them. Such areas could be used to advantage for permanent meadow on farms where hay land is scarce.

GROUP B–5

A heavy-textured surface layer and subsoil, a high to very high lime content, and good water-holding capacity are characteristic of the seven soils of group B–5: Carbo stony silty clay loam; Chilhowie stony clay, severely eroded and severely eroded steep phases; Dunmore silty clay loam, eroded steep phase; Frederick-Eliber stony silt loams, steep phases; Hagerstown stony silt loam, steep phase; and Rolling stony land (limestone material). Except Chilhowie stony clay, severely eroded phase, they are too stony or too steep, or both, for the use of farm machinery. They produce similar pasture plants, consisting of bluegrass, white clover, crabgrass, broomsedge, poverty oatgrass, and other native plants, and the pastures require similar management in most places. Alfalfa is grown successfully on some
of the soils, especially on Chilhowie stony clay, severely eroded phase, and Carbo stony silty clay loam.

Present management.—A large part of the soils of group B–5 has been cleared, although 15 to 25 percent of Hagerstown stony silt loam, steep phase, and Rolling stony land (limestone material) is under forest. Pasture is the predominant use. Small acreages of the Carbo and Chilhowie soils are cropped to corn and alfalfa, and there is one large orchard on Carbo stony silty clay loam. The management for permanent pasture on some farms includes close grazing, some clipping of undesirable herbage, little or no scattering of droppings, not much seeding, and the application of small quantities of fertilizer.

Management requirements.—The group B–5 soils seldom need lime for the production of permanent pasture. Liming the areas where the soils are alkaline or very alkaline tends to lock up or fix plant nutrients, as phosphoric acid, and render them slowly available to the plants. In general, the fertilizer mainly required is phosphoric acid, which can be supplied by 20-percent superphosphate, or its equivalent, in applications every 4 to 6 years of 400 to 600 pounds an acre.

Undergrazing seems to be undesirable. The pastures should be grazed closely, and overgrazing can be allowed sometimes when continuous grazing is practiced.

No seeding is needed, as the soils in pasture already sustain good stands of white clover and bluegrass, which reseed rapidly where good management is practiced. Clipping pastures must be done by hand, but generally very little clipping is needed. Although scattering droppings to bring about uniform pasture growth is a good practice, it is needed less on these soils than on soils of groups B–3 and B–4.

Locust and walnut trees grow well on group B–5 soils, and shade afforded by them is very important in pasture production.

GROUP B–6

The two soils of group B–6 (Hayter and Jefferson stony fine sandy loams, hill phases) differ from those of group B–3 mainly in having steeper slopes. Only a few areas can be traversed easily with machinery for distributing lime and fertilizer.

Present management.—Practically all of the Hayter soil in group B–6 has been cleared and is used for pasture, but about 65 percent of the Jefferson is under forest. A part of the cleared acreage is idle, parts are used for crops, chiefly corn, and the rest for pasture. The cropped areas in general are deteriorating in their ability to produce crops.

Management requirements.—Management of B–6 soils for pasture requires practices that will help control runoff and reduce soil loss. Lighter grazing and heavier fertilization and liming are suggested for these soils than for those of group B–3. The applications of fertilizer should not be less than 600 pounds an acre, and the kinds for pasture are the same as those for pasture on the soils of group B–3. The other management requirements are similar to those of that group.

GROUP B–7

Argillaceous limestone, purple calcareous sandstone, or impure dolomitic limestone containing beds of sandstone underlies the eight soils
of group B-7 (Bolton loam, steep phase; Carbo silt loam, steep phase; Carbo very fine sandy loam, steep phase; the hilly and steep phases of Clarksville cherty loam; the steep phase of Clarksville cherty silt loam; Lodi cherty loam, steep phase; and Tellico very fine sandy loam, steep phase). The slopes are steep (24 to 50 percent) though in some areas they are milder. The soils range from cherty loam to silt loam in texture and generally have fairly deep profiles over bedrock. Some are moderately eroded, but most of them have fairly thick surface soils. They have a low to moderate supply of organic matter and a low supply of essential plant nutrients. Most of them are strongly acid. The Clarksville and Lodi soils have small fragments of chert on the surface and in the profile but are relatively free from limestone outcrops.

The soils of this group are too steep in most places for the use of heavy machinery. Most of them have rapid or very rapid external drainage, and if unprotected are easily eroded. All have similar management requirements and grow similar pasture plants. They are poor to fair pasture land and are among the least desirable of the Fourth-class soils for this use. Pasture vegetation on the unfertilized land consists principally of broomsedge, smilax, cinquefoil, dewberry, poverty oatgrass, and other undesirable plants, and some bluegrass, white clover, and crabgrass. Of this group, the Clarksville soils are the least desirable for pasture and Carbo silt loam, steep phase, the most desirable.

**Present management.**—Clarksville and Lodi soils have large areas under forest, but much of the Carbo and Tellico soils is cleared. Most of the cleared area is used for pasture and the small part cultivated is used chiefly for corn. Present management for pasture includes seeding, haphazard grazing, little or no clipping of undesirable herbage, some burning, and some scattering of feed. Phosphatic fertilizer is applied to some pastures, but little lime is applied.

**Management requirements.**—On soils of group B-7, 400 to 500 pounds an acre of 4-12-4 or 4-16-4 fertilizer and 1½ to 2 tons of ground limestone, or equivalent, are sufficient for pasture land until legumes and durable grasses are well established and the carrying capacity of the pastures has increased so that cattle droppings partly cover the land. Thereafter, 400 to 600 pounds of 20-percent superphosphate, or its equivalent, every 3 or 4 years is sufficient, provided other management is properly practiced. Good results are obtained in establishing and maintaining new pastures on eroded land from about 400 pounds of superphosphate and 10 tons of manure every 3 or 4 years.

Grazing should be regulated so as to keep pace with the growth of the grass. Continuous grazing should be avoided until the grasses have made a fairly good start. Close grazing can then be allowed, and the pasture should be kept below 4 inches in height if possible. Lanes to watering places and the hauling of feed on the land should, wherever possible, be along the contour.

Most of the soils of this group have enough bluegrass and white clover to reseed the land. Some eroded areas, however, may have to be seeded for quick establishment of pasture. Two or three bluegrass or white clover plants on each square yard of the land will, under good management, rapidly reseed the sward.
If the land is to be seeded, complete fertilizer and lime, or phosphate and manure should be applied and the seeding should consist of a mixture of grasses. Suitable fertilization consists of 400 to 600 pounds an acre of 4–12–4 or 3–12–6 mixture, or the equivalent, and suitable liming, 2 tons of ground limestone. Manure and phosphate are better for eroded areas than a complete fertilizer. A suggested pasture mixture and the quantity of each ingredient are the following: Kentucky bluegrass, 8 pounds; redtop, 3 pounds; timothy, 5 pounds; perennial ryegrass, tall oatgrass, or orchard grass, 5 pounds; and white clover, 1 pound. Plowing the land for seeding is difficult on most of the soils of group B–7, but disking is fairly easy on some areas.

Clipping undesirable plants in the pastures is very difficult and in most places has to be done with hand tools. Either clipping the pastures or feeding cattle on them to trample the undesirable herbage probably helps to establish good pasture sooner than other means. Scattering the droppings also is good practice, though it is difficult and not everywhere necessary.

Locust and walnut trees are beneficial to pastures on these soils, and grazing farm woods is not advisable unless they consist largely of these trees.

GROUP B–8

Except for Wellston loam, hilly phase, the soils of group B–8 (Dandridge silt loam, eroded and eroded hilly phases; Dekalb loam; Teas silt loam; Teas-Dandridge silt loam, eroded phases; and Teas-Litz silt loams, eroded and eroded steep phases are underlain by slightly calcareous shale, interstratified with sandstone and, in most places, some impure limestone. They have similar physical characteristics and management requirements. The relief generally is hilly to steep.

All the soils—except Wellston loam, hilly phase, which is moderately deep—are shallow to bedrock and most of them have shale particles on the surface and throughout the profile. They have low water-holding capacity and dry out readily. In most places runoff is rapid to very rapid, and in many places most of the surface layer has been removed by erosion, the most severe erosion being on west slopes.

The soils of this group are moderately low in lime and other plant nutrients and low in organic matter. The pasture vegetation generally consists of poverty oatgrass, broomsedge, smilax, plantain, hawkweed, ragweed, crabgrass, and some bluegrass and white clover. The carrying capacity of the pastures is low to very low in most places.

Present management.—Much of the uneroded soils of group B–8 are under forest. About half of the cleared acreage is pastured and the rest is either cropped or idle. Corn is the chief crop, with a smaller acreage of wheat and lespedeza. Corn is commonly grown for several years in succession, after which the land lies idle for a period. Only small quantities of fertilizer are used. Most of the pastures are undergrazed and not fertilized, limed, clipped, or otherwise properly managed.

Management requirements.—From 1 to 1½ tons an acre of ground limestone, or its equivalent, applied to B–8 soils every 3 or 4 years should keep their reaction favorable for pasture plants. From 400 to 600 pounds of 4–12–4 or 3–12–6 fertilizer, or the same quantities of
20-percent superphosphate and 6 to 10 tons of manure should be applied until good pasture is established and the carrying capacity greatly increased. When this has been done, from 400 to 600 pounds of 20-percent superphosphate, or its equivalent, every 3 or 4 years should give good results. The amendments have to be applied to most areas by hand or light machinery because of the roughness of the land.

Grazing should be regulated according to the increase in the pasture. Brief periods of close grazing are suggested, but extended periods are to be avoided. Dry seasons considerably reduce the pasture, and at such times close grazing should not be permitted.

There are usually enough desirable plants to reseed the land if proper fertilization and other good management are followed. Clipping the pastures will help kill undesirable plants, but it is difficult on these soils. The trampling of cattle around feeding places will quickly kill undesirable herbage in the trampled areas if other factors are favorable. Scattering the droppings and establishing a sparse stand of black locust and walnut trees are beneficial to the pastures—probably more so than on soils of any other pasture-adapted group in the county.

SOILS BEST SUITED PHYSICALLY TO FOREST

A large total acreage of the soils in group C is much better suited physically to forest than to crops or pasture; and most of the present forest is on soils of this kind. The following soils make up this group: Bolton loam, eroded steep and very steep phases; Dandridge silty loam, very steep phase; Elliber cherty silt loam, very steep phase; Lehew stony very fine sandy loam; Limestone rockland; Litz sandy loam; Lodi cherty loam, eroded steep and very steep phases; Montevallo shaly silt loam and its hilly phase; Muskingum loam, stony loam, and stony very fine sandy loam; Riverwash; Rough gullied land (limestone and shale materials); Rough stony land (limestone material); Rough stony land (Muskingum soil material); Sandstone rockland; Teas silt loam, very steep phase; Teas-Dandridge silt loams, very steep phases; Teas-Litz silt loams, very steep phases; Westmoreland silt loam, very steep phase; and Westmoreland silty clay loam, eroded very steep phase. Like the soils suited physically to pasture and crops, however, the use of these soils cannot always be adjusted to their best physical use suitability, because of many other factors. The soils differ greatly in degree of suitability for forest. Thus, although Muskingum stony loam and Rough gullied land (limestone and shale materials) are both suited physically to forest, the usefulness of certain species varies on each.

As with soils suited physically to crops and to pasture but not to crops, it is difficult to draw a definite line between soil and forest management. It is felt, however, that the production of forest involves more forest management than soil management. Accordingly, it may be more feasible to subdivide this group of soils on the basis of forest-management than of soil-management requirements. For example, the kinds of trees, the density of stand, and the methods of harvesting the timber are different on Montevallo shaly silt loam, hilly phase, from those on Westmoreland silt loam, very steep phase, though the soil-management practices involved in forest production on these two soils do not differ greatly.
Most of the management practices involved in forest production have to do with: (1) Maintenance of a full stand of suitable species; (2) control of fire, browsing, trampling, and damage from the use of harvesting equipment and from other causes; (3) systematic cutting and weeding; and (4) harvesting the mature trees in a manner to provide for their replacement by desirable species. Practices in the first, third, and fourth of these groups pertain to forest management, and those of the second group pertain to both soil and forest management.

Information accumulated by the State on the management requirements of various crops and on fertilizing and liming for Virginia conditions has been used in the discussion of requirements for good soil management. Listed below are some of the publications that give information applicable to the use and management of the soils in the county:

**Virginia Agricultural Experiment Station technical bulletins:**

53. The Effects of Mulched and Turned Rye In the Green and Mature Stages on the Liberation of Plant Nutrients from a Silt Loam Soil

54. The Conservation of Burnt Lime, Limestone, Dolomite, and Calcium Silicate in Soils as Influenced by Methods of Incorporation

60. The Liberation of Plant Nutrients from the Soil as Affected by Alfalfa

61. The Effects of Certain Lime Materials on the Leachings from Frederick Silt Loam Soil

73. The Effect of Green-Manure Crops on Certain Properties of Berks Silt Loam

75. The Effect of Certain Nitrogenous Fertilizers on the Chemical and Vegetative Composition and Yield of Pasture Plants

78. Pasture Production as Affected by Type and Chemical Composition of the Soil

**Virginia Agricultural Experiment Station bulletins:**

317. Fertilizer and Manure Experiments on Dunmore Silt Loam Soil

328. Experiments with Lespedeza

330. Lime and Fertilizers Improve Pastures

336. Effects of Boron on Yield and Duration of Alfalfa

339. Rotation and Fertilizer Experiments in Southwest Virginia

**Virginia Agricultural and Mechanical College and Polytechnic Institute, Extension Agronomy Department bulletin:**

97. A Hand Book of Agronomy

**ESTIMATED YIELDS AND PRODUCTIVITY RATINGS**

The average yields that can be expected from various crops for each soil in the county are given in table 10. Three yields are shown for most crops, corresponding to those that can be expected on the average under three different kinds of treatment.

In columns A, the yields are those expected without special practices to restore, maintain, or increase productivity. No manure or commercial fertilizer and no lime or other amendments are used, and no special effort is made in the selection and rotation of crops to return organic matter and nitrogen to the soils. Most of the ratings in this column are based on crop yields obtained on land cleared of forest for 2 or 3 years, or even longer, depending on the particular soil in question.

In columns B, the yields are those expected under prevailing soil-management practices. The most common practices include the rota-
tion of crops, and the use of fairly low to moderate quantities of commercial fertilizer in the production of corn, wheat, small grain, and tobacco. Rotations of 3 and 4 years are most commonly followed. Manure is applied in small quantities to some land, but occasionally in rather large quantities. Lime also is applied to the land used for some of the crops grown in the rotations. Hay crops and permanent pastures are seldom given a top dressing of fertilizer or lime, but the land for alfalfa generally is given rather heavy applications. Small spots in permanent pastures may be manured every few years.

Common management practices are not the same on all soils. The yield data in columns B for tobacco and pasture are for the management described on most soils. For most of the other crops common management practices vary among the soils, and reference should be made to the soil in question in its management group in the section on Present Management and Management Requirements of Soils.

In columns C, the yields represent those expected of crops under good management. Good management refers to the proper choice and rotation of crops; the correct use of commercial fertilizer, lime, and manure; proper tillage methods; the return of organic matter to the soil; and engineering measures, where necessary, for the control of water on the land to maintain or increase soil productivity within practical limits. Good management is discussed under management requirements for soils in the management groups in the section Present Management and Management Requirements of Soils.

The yields in table 10 are based as far as possible on data obtained from experiment stations on similar soils, from records and experiments made on certain soil types throughout the area, from yields reported by farmers in the county, and from similar sources. Where sufficient data are not available the yields are obtained by comparison with soils on which data are available, by field observations, and by consultation with farmers, county agricultural agents, and agricultural specialists.

Knowledge of the requirements for good management of specific soils is limited. Some deficiencies of the soils, however, are known reasonably well; others are less well known. From this knowledge, some of the requirements for good management are treated in the section on Present Management and Management Requirements of Soils. Reference should be made to that section for the definition of the level of management for which the yields of columns C are given.

Data are scarce on crop yields obtained under conditions that approach good management. The expected yield estimates in columns C, therefore, are based largely on the best judgment of men who have had experience with the soils and the crops.

The yields listed in columns C may be thought of as production goals attainable by feasible practices of good management. The same goal probably can be reached by several different combinations of the management practices here listed for any one soil and crop. Some of these practices are essential to good management, and some may supplement or replace others. The best choice depends on the farm business as a whole. On one farm it may be practicable to manage the soil so that the yields exceed the goal; on others it may not be practicable to reach it. The best practical management for a farm unit may give yields above the goal for one crop and soil, and yields
below the goal for another crop on the same soil. The yields listed in columns C give some idea of the responses that can be expected from good management when compared with the yields listed in columns A and B.

The expected yields of various crops on the soils of the county have been converted in table 11 into indexes, and the soils grouped according to relative physical suitability for agricultural use.

The rating compares the productivity of each of the soils for each crop with a standard of 100. This standard index generally represents the approximate average acre yield obtained without the use of fertilizers and other amendments on the more extensive and better soils 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 a soil having the standard index. Soils given amendments, as lime or commercial fertilizers, or unusually productive soils may have productivity indexes of more than 100 for some crops.

The indexes of the productivity rating table are the expected yields of table 10 expressed as percentages of the standard yields adopted for the country as a whole:

\[
\text{Productivity rating index} = \frac{\text{Expected yield}}{\text{Standard yield}} \times 100.
\]

The standard yield on which the indexes are based are given in the table under the names of the crops for which the ratings are given. Columns A, B, and C under each crop refer to three levels of management and correspond to similar columns in the table of expected yields for which the levels of management are defined.

The soils are listed in the productivity rating table in the approximate order of their general physical suitability for the important crops of the present agriculture under prevailing management practices.

The ratings or the yields they represent cannot be interpreted directly into land values; for distance to market, relative prices of farm products, association with other soils of different capability, and many other factors influence the land values at specific places. They, however, can be used (1) for comparing the productivity of specific crops on different soils within the county and on soils of Scott County with reference to other parts of the United States; (2) to show crop responses that can be expected from different levels of management; (3) with other information, to estimate the total production of crops by soil areas and the production capacity of the soil area; and (4) to help compute the probable income from a farm under different plans of operation.

**WATER CONTROL ON THE LAND**

Water control on the land includes practices that will maintain favorable soil-moisture conditions for plant growth, as follows: (1) Regulation of runoff, (2) protection from floods, (3) drainage, and (4) irrigation.

In Scott County irrigation is of little or no importance at the present time, though it doubtless would increase production of crops on many soils in dry seasons. Its use to supplement rainfall might prove economically feasible under some conditions, especially on gardens and on small areas of high-value truck crops.
Artificial drainage of some areas of poorly drained soils has been accomplished by open ditches. Little tiling has been done. Drainage is a minor problem on most of the farms.

Little has been done in this county to protect areas from floods, though the overflow of streams occasionally causes considerable damage. Most floods occur early in spring before crops are on the land, and flooding is not so serious a problem as on areas farther from the source of the streams.

Maintaining as favorable soil-moisture conditions for plants as is feasible and controlling runoff are of major importance in the control of water on the land. Many soils have qualities that cause more rapid runoff than is desirable and many can be improved by increasing the absorption and retention of moisture.

There may be two direct undesirable results from runoff: (1) Loss of water that could have been useful to plants and (2) loss of soils. Loss of water always results; loss of soil material may or may not accompany such loss. Of the two, the loss of soil material is the most apparent because it leaves the soil in an eroded condition and its effects are generally cumulative.

Conditions that contribute to the loss of water and to the loss of soil cannot be corrected separately. Such losses are intimately associated with their causes and in their effect one on the other. Conservation of both water and soil can be accomplished through the proper control of water on the land.

In the Tennessee Valley area, of which Scott County is a part, a series of dams has been constructed to control and use the water in the streams for the betterment of the people. These dams make navigation possible on the waterways, decrease floods by regulating the volume of flow, and provide a waterhead for the production of electricity. Their effectiveness depends to a large extent on their capacity to regulate the volume of flow of the large streams. Most of the streams are feeders of the main river system, and any measures that regulate the flow of water from the land drained by these streams increase the effectiveness of the entire system of dams.

Water is a natural resource to be utilized on the land as well as in the streams. It is necessary for the growth of plants, and even in a region of high rainfall, such as the one in which Scott County is situated, lack of water is commonly a limiting factor in the growth of plants during certain periods of the year. Any measures that bring about a more nearly adequate and even supply of water during the growing season promote increased production of the plants on which the people on the land depend for their livelihood.

Effective use of water by plants may be limited by other factors. In this county one of the major limiting factors is the supply of mineral plant nutrients in the soil. If the water that falls on the land is to be used most effectively by plants, a sufficient quantity must remain in the soil for the needs of the plants, an adequate supply of plant nutrients must be available to the plants, the physical condition of the soil must be favorable to the development of plant roots, and plant diseases and destructive insects must be controlled.

Runoff is retarded by vegetation in proportion to the density of the cover and the ability of the vegetation to produce a soil condition favorable to the absorption and retention of moisture. In addition,
the vegetative cover and its root system and debris decrease loss of soil material by reducing the rate of runoff and by binding the soil particles. Forests play an important part in runoff control; sod-forming plants, as hay and pasture grasses and legumes, are effective; close-growing crops (small grain) are somewhat less important than sod-forming crops; and intertilled crops are generally least effective.

Several soil characteristics have a direct bearing on the problem of runoff control. Of these, slope is of outstanding importance. Where other soil characteristics are similar, the soils having a steep slope are the most subject to damage by runoff and have the most restricted suitability for agricultural use. In contrast, those that have a smooth or nearly level surface are the least subject to damage by runoff and in general have the greatest range of suitability for agricultural use. Other physical characteristics of the soil that have an important bearing on the problems of runoff control are consistence, texture, and depth of bedrock. In general, land use and crop rotations should be adjusted to protect the soils by a sufficient cover of vegetation, determined by the rapidity and volume of the runoff and by the physical characteristics of the soil.

To be most effective in the control of runoff the vegetative cover on cropland and pasture land should have vigorous growth. Suitable applications of lime, manure, and fertilizers and the use of legumes in the crop rotations are practices that help make plant growth vigorous. Agricultural lime supplies the plant nutrient calcium and adjusts the acidity of the soil. Manure supplies nitrogen, potash, and organic matter and aids in keeping the soil in good physical condition. Mineral fertilizers supply nitrogen, phosphorus, and potash, and they may be used to supply minor nutrient elements as well. If properly inoculated, legumes fix nitrogen obtained from the air. Their roots add organic matter to the soil and thus aid in keeping the soil in good physical condition. As such practices promote vigorous growth of crops in the rotation, they are desirable not only in the control of runoff but in the effective use of water in the soil for the production of crops.

The soils should be so tilled that runoff will be retarded and water easily absorbed. Tillage operations, moreover, should be carried on at such a time and in such a manner that the land is bare of vegetation for as brief a period as possible. Contour tillage is desirable on many slopes because it impedes runoff. Contour strip cropping may be desirable on the steeper slopes, and it is generally most feasible and most desirable on long slopes.

Engineering measures for the control of runoff, as terracing, are commonly expensive. On many soils terraces seem to lower the productivity, which may be restored only by considerable effort. Terraces must be maintained in good condition to be effective because those poorly kept may be worse than none at all. Under certain conditions, terraces have a place in the control of runoff but are to be employed only when other measures, consisting principally of good soil management for good production, are not sufficient.

Like all other management practices, measures for the control of water on the land depend not only on the soil itself but on particular conditions within the farm unit. Each farmer should choose the particular combination of practices required by his farm unit for the
maximum of feasible water control. Moreover he should choose prac-
tices that provide the maximum water control consistent with the
most favorable production of crops, pasture, and forest. Effective
control of water is obtained on many farms and can be obtained on
many more by the use of soil-management practices that are sound
from the standpoint of efficient production.

The control of water is thus not an isolated problem. It involves all
practices of good soil management ordinarily employed. Water con-
trol is a part of successful crop production. It can be accomplished
largely through good farming practices, including the proper choice
and rotation of crops, proper fertilization and tillage, the control of
insects, pests, and diseases, and in some places by engineering means.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of soil-forming processes acting on materials de-
posited or accumulated by geologic agencies. The characteristics of
the soil at any given point are determined by (1) the climate under
which the soil material has accumulated and existed since accumula-
tion; (2) the plant and animal life on the soil and in it; (3) the physi-
cal and mineralogical composition of the parent material; (4) the
relief, or lay of the land; and (4) the length of time the forces of soil
development have acted on the parent material. The climate, and its
influence on soil and plants, depends not only on temperature, rainfall,
and humidity but also 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.

Climate and vegetation change the parent material from an inert
heterogenous mass to a body having more or less definite genetic
morphology. Their action on the parent material is accelerated or
retarded to varying degrees by the relief, which determines to some
extent the runoff and movement of water through the soil, natural
erosion, and natural vegetation. The character of the parent material
aids climate and vegetation in soil formation and is important in
determining the kinds of natural vegetation. Throughout the genesis
of soil, time brings about changes; hence, age is a factor in the
development of the soil into a body in equilibrium with its environ-
ment. The degree of soil development depends not only on time but
also on the rate at which the forces of climate and vegetation act,
these, in turn, being regulated by the character of the relief and parent
material.

Higher plants, micro-organisms, earthworms, and other forms of
life live on the soil and in it and contribute to its morphology. The
nature of the changes they bring about depends, among other things,
on the kind of life and the life processes peculiar to each. The kinds
of plants and animals are largely determined by the kinds of climate,
parent material, and relief, and by the age of the soil. Climate is
most effective, although not always most important, in determining
the kinds of higher plants and through these exerts a powerful
influence on the morphology of soils.
ENVIRONMENT AND GENERAL CHARACTERISTICS OF SOILS

The climate is temperate and humid in Scott County. The mean annual temperature at Pennington Gap, in adjoining Lee County, is 55.2° F., though the seasonal temperatures vary somewhat. The county ranges in elevation from about 1,200 feet on the lowest valley floor to about 4,000 feet on the highest mountaintop; and although differences in elevation cause some differences in temperature, no results therefrom are apparent in the character of the soil profile. The soils are frozen to comparatively shallow depths and for brief periods in winter; hence leaching is impeded very little by frozen ground. The mean annual rainfall at Clinchport is 48.51 inches and the average depth of annual snowfall, 13.1 inches. The rainfall is fairly evenly distributed throughout the year but is somewhat greater in winter, spring, and summer than in fall. Although calcium carbonate is a mineral constituent of many of the rocks underlying the county, its accumulation has nearly everywhere been prevented by leaching. In a few places on the uplands and in some places on the first bottoms the soil is alkaline.

Results of pH determinations of samples of typical profiles of important soils in the county are given in table 12.

<table>
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<th>Soil type and sample No.</th>
<th>Depth (Inches)</th>
<th>pH</th>
<th>Soil type and sample No.</th>
<th>Depth (Inches)</th>
<th>pH</th>
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<td>30–40</td>
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<td>Elliber cherty silt loam:</td>
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<td>642</td>
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<td>643</td>
<td>34–42</td>
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</table>

See footnote at end of table.
### Table 12.—pH determinations of soils of Scott County, Va.1—Con.

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<tr>
<th>Soil type and sample No.</th>
<th>Depth</th>
<th>pH</th>
<th>Soil type and sample No.</th>
<th>Depth</th>
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<td><strong>Inches</strong></td>
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<tr>
<td>Greendale silt loam:</td>
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<td>Pisgah silt loam:</td>
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<tr>
<td>644</td>
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<td>4.7</td>
<td>673</td>
<td>35-45</td>
<td>4.7</td>
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<td>Monongahela fine sandy loam:</td>
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<td>Dandridge silt loam, eroded phase:</td>
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<tr>
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<td>22-35</td>
<td>5.5</td>
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<td>10-24</td>
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</tr>
<tr>
<td>Leadville silt loam:</td>
<td></td>
<td></td>
<td>Lehev stony very fine sandy loam:</td>
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<td></td>
</tr>
<tr>
<td>650</td>
<td>0-7</td>
<td>6.0</td>
<td>677</td>
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<td>679</td>
<td>22-35</td>
<td>5.2</td>
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<td>Montevallo shaly silt loam:</td>
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<td>Waynesboro fine sandy loam, sloping phase:</td>
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<td>653</td>
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<td>680</td>
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<td>654</td>
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<td>Frederick cherty silt loam:</td>
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<td>682</td>
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<td>Holston fine sandy loam:</td>
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<td>Allen fine sandy loam:</td>
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<tr>
<td>659</td>
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<td>10-38</td>
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<td>Tellico very fine sandy loam, eroded phase:</td>
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<tr>
<td>662</td>
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<td>Carbo silt loam, rolling phase:</td>
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<tr>
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<td>4.9</td>
<td>691</td>
<td>0-6</td>
<td>5.4</td>
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<tr>
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<td>692</td>
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<td>Philo fine sandy loam:</td>
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<td>Camp silt loam:</td>
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<td>Tumbez silt loam:</td>
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</table>

1 Determinations made in the laboratory of the agronomy department, Virginia Agricultural Experiment Station, by the glass-electrode method.

Most of the region in which Scott County is situated was originally covered with forest, and the soils were developed under a forest consisting largely of oak, hickory, tuliptree, and other deciduous trees. During soil formation relatively only a small quantity of organic matter derived from the forest became incorporated with the soil. In the present forested areas, which are confined mainly to the mountains and to steep and rough valley uplands, a thin layer of forest litter and leafmold covers the soil, and a small quantity of organic matter, derived from decayed leaves, bark, and twigs, is mixed with
the upper inch or so of the surface layer. In favorable places a relatively large quantity of decayed vegetable matter has accumulated in the surface layer on some high places on mountains.

In some soils on uplands underlain by limestone and in some soils on colluvial slopes and first bottoms, a fairly large quantity of well-decomposed organic matter is apparently incorporated with the mineral matter of the surface layer. This condition may be the result of a heavier growth of forest or a thicker growth of small native vegetation than on the thinner, less fertile, or drier soils on cherty and shaly ridges and on mountains underlain by sandstone. Differences in the kind of organic material and the rate of decomposition may be partly the cause of differences in the organic-matter content of the soils.

Trees that commonly grow in this region are moderately deep to deep feeders and shed their leaves annually. The leaves range considerably among the species in content of plant nutrients. In general, however, the quantity of bases and phosphorus returned to the soil by leaves of deciduous trees is high compared with that returned by leaves of conifers. Essential plant nutrients thus are returned to the upper part of the soil from the lower part by trees.

Organic material derived from the various plants is acted on by micro-organisms, earthworms, and other forms of life and by direct chemical reactions. The rate of decomposition of such material is rather rapid as a result of the favorable temperature and moisture conditions, the favorable character of the organic material itself, and presumably the favorable micro-population of the soil. Organic material does not accumulate on well-drained sites in this county to the extent that it does on similar sites in cooler regions.

The well-drained, well-developed soils of the county have developed under relatively similar conditions of climate and vegetation. It is on these soils that climate and vegetation have had maximum influence, and relief and age a minimum modification. As a result, the soils developed from various kinds of parent materials have many characteristics in common.

As the climate and the vegetation doubtless have been relatively constant, they may not be considered the major causes of the great differences in the morphology of the soils throughout the county. Hence, time and the character of parent material and relief are the factors that have largely brought about the differences in morphology.

The parent materials of the soils consist of two classes: (1) Residual material derived from the decomposition of rocks in place; and (2) transported material or material removed from its original position and deposited on valley uplands or along streams. The first class is composed of the residuum of weathered limestone and the soft material of weathered sandstone and shale. The second class includes rock fragments and other rock waste removed mainly by gravity from mountainsides and deposited on valley uplands, rainwash and slough material deposited at the foot of slopes mainly in the valley uplands, and alluvial material washed from upland slopes and laid down near streams by running water. The alluvial material occupies positions on stream terraces and first bottoms.

In general, the soils are light in color and range from brown, brownish yellow, and yellowish brown to grayish yellow and light
gray in the surface layer and from reddish brown and brownish red to light brown, brownish yellow, yellowish brown, and yellow in the subsoil. The texture of the surface layer and of the subsoil is prevailing-ingly fine. In many places angular rock fragments are on the surface and throughout the profile of soils on the mountains and on the valley uplands near the foot of mountains. Chert and in some places shale fragments are strewn over the surface and mixed with the profile of soils on many of the ridges in the valley uplands; and many outcrops of limestone bedrock are present in the limestone belts. The surface layer is mostly friable but fairly heavy-textured and somewhat plastic in some places. The subsoil is generally friable, though in some places rather tough or plastic.

Scott County is in the transitional belt between the Gray-Brown Podzolic and the Red and Yellow Podzolic soil regions of the Eastern States, and zonal soils of each of these great soil groups are represented in the county. A zonal soil is any one of the great groups of soils that have well-developed soil characteristics reflecting the influence of the active factors of soil genesis—climate and living organisms, mainly vegetation. Azonal soils, also in the county, are any group of soils that, because of their youth or conditions of parent material or relief, do not have well-developed soil characteristics.

Some of the soils developed from residual material of weathered rock in place are on undulating to rolling upland and have characteristics common to soils of similar relief and age throughout the region. These are zonal soils. Other soils of the uplands are on slopes so steep that much material is removed by normal erosion and much rain water runs off instead of soaking into the soil. Where the normal effects of climate and vegetation are modified by steep relief and resistant rocks the soils remain young and have few characteristics of the zonal soils. These are azonal soils. Within both the zonal and azonal soils of the uplands there are marked differences resulting from differences in the parent rock.

In some areas the transported materials have been in place a long time and in others a very short time. Soils derived from those in place a long time have developed many of the characteristics of the mature soils of the uplands; and the differences are attributable largely to differences in the character of the parent material, as texture, consistence, and mineral composition. Materials that have lain in place only a brief time have few of the characteristics common to the mature soils of the uplands and of old-stream terraces, mainly because of age; but in these young soils differences may be due either to the composition of the parent material or to the effect of relief on drainage. These young soils are azonal.

Some of the soils developed from residual material in place and some developed from transported material have a well-developed profile, but profile development has been influenced by extreme character of parent material, by extremes of relief that inhibit drainage, or by extreme age. Although well developed, these soils have few characteristics of the zonal soils and are intrazonal.

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*United States Department of Agriculture, Soils and Men. U. S. Department of Agriculture Yearbook 1938, 1232 pp., illus. 1938.*
The profile of the normal, or zonal soils, has a light-colored and light-textured surface layer, or A horizon, that overlies a thicker and heavier textured layer, or B horizon. The B horizon, in turn, overlies the parent-material layer, or C horizon, which ranges considerably in texture, but in some places is lighter than the B horizon and nearly everywhere heavier than the A horizon.

The texture of the profile layers differs somewhat among the various zonal soils in the county. In the A horizon the textures are mainly silt loam, loam, and to a less extent fine sandy loam and silty clay loam. Rock and chert fragments modify the texture of the A horizon in many areas. In the B horizon the textures are mainly silty clay loam, silty clay, and fine sandy clay. In the C horizon the materials are variable, depending on the character of the parent rock and the degree of weathering. The materials may be silty clay loam, silty clay, or fine sandy clay, intermixed in many places with decomposing rock or chert fragments. The thickness of the horizons differs somewhat in different soils. That of the A horizon ranges from 5 to 15 inches; the B horizon, from 10 to 33 inches; and the C horizon, which consists mainly of weathered rock, from about 1 foot to more than 8 feet.

The profile of the azonal soils has a light- to dark-colored A horizon of fine texture and friable consistence. Apparently no zone of illuviation, or B horizon, has developed; and the A horizon passes into the parent material, which generally has lighter color than the A horizon but may have similar or heavier texture. The parent material consists of alluvium or of decayed rock in varying stages of decomposition. The azonal soils may be considered AC soils because the B horizon generally is lacking.

Under virgin conditions, a thin layer of decayed organic matter covers both the zonal and the azonal soils. Decomposed organic material is mixed with the mineral material of the A horizon in varying quantities and to different depths, according to the character of the soil and other conditions of environment.

The profile in intrazonal soils differs according to the factor of soil formation that was most influential in causing their abnormal development.

CLASSIFICATION OF SOILS

The soil series are here classified according to established great soil groups, and detailed profile descriptions of members of the series are given. The soil series of the county are listed in table 13, and for each are given the order, great soil group, relief, internal drainage, and parent material. The great soil groups in the county are (1) Gray-Brown Podzolic soils, (2) Yellow Podzolic soils, (3) Red Podzolic soils, (4) Rendzina soils, (5) Half Bog soils, (6) Planosols, (7) Lithosols and lithosolic Gray-Brown Podzolic soils, and (8) Alluvial soils.
<table>
<thead>
<tr>
<th>Great soil group and series</th>
<th>Relief</th>
<th>Internal drainage</th>
<th>Parent material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gray-Brown Podzolic soils:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisgah</td>
<td>Gently undulating to rolling</td>
<td>Medium</td>
<td>Eluvium from the weathering of—</td>
</tr>
<tr>
<td>Hagerstown</td>
<td>Undulating to steep</td>
<td>do</td>
<td>Limestone.</td>
</tr>
<tr>
<td>Dunmore</td>
<td>Hilly and steep</td>
<td>do</td>
<td>Do.</td>
</tr>
<tr>
<td>Frederick</td>
<td>Undulating to steep</td>
<td>do</td>
<td>Do.</td>
</tr>
<tr>
<td>Elliber</td>
<td>Undulating to very steep</td>
<td>do</td>
<td>Cherty limestone; an abundance of chert from the weathered rock in the profile.</td>
</tr>
<tr>
<td>Lodi</td>
<td>Gently rolling to very steep</td>
<td>do</td>
<td>Cherty limestone; many chert fragments derived from the weathered rock mixed through the profile.</td>
</tr>
<tr>
<td>Bolton</td>
<td>Rolling to very steep</td>
<td>do</td>
<td>Limestone, the formation containing thin beds of sandstone.</td>
</tr>
<tr>
<td>Carbo</td>
<td>Rolling to steep</td>
<td>Medium to fairly slow</td>
<td>Limestone, with sandstone in the formation.</td>
</tr>
<tr>
<td>Wellston</td>
<td>Hilly</td>
<td>Medium</td>
<td>Limestone, the formation platy or containing thin beds of shale.</td>
</tr>
<tr>
<td>Hayter</td>
<td>Very gently sloping to very strongly sloping</td>
<td>Medium to rapid</td>
<td>Noncalcareous sandstone, the formation containing some noncalcareous shale.</td>
</tr>
<tr>
<td>Emory</td>
<td>Nearly level to strongly sloping</td>
<td>Medium</td>
<td>Colluvium derived from uplands underlain by noncalcareous sandstone and shale and some calcareous rock.</td>
</tr>
<tr>
<td>Camp</td>
<td>Nearly level to gently sloping</td>
<td>do</td>
<td>Colluvium and local alluvium derived from uplands underlain by—</td>
</tr>
<tr>
<td>Sequatchie</td>
<td>Nearly level to gently sloping</td>
<td>do</td>
<td>Mainly limestone.</td>
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</tbody>
</table>

Soil Survey Series 1939, No. 13
<table>
<thead>
<tr>
<th>Yellow Podzolic soils:</th>
<th>Rolling to steep.</th>
<th>do</th>
<th>Eluvium from the weathering of—— Cherty limestone, the formation containing sandstone in places; much chert derived from the weathered rock in the profile.</th>
</tr>
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<tbody>
<tr>
<td>Clarksville</td>
<td></td>
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<td>Colluvium derived from uplands underlain mainly by noncalcareous sandstone.</td>
</tr>
<tr>
<td>Jefferson</td>
<td>Very gently sloping to very strongly sloping.</td>
<td>Medium to rapid</td>
<td>Colluvium and local alluvium derived from uplands underlain by—— Limestone, shale, and some sandstone. Noncalcareous shale mainly.</td>
</tr>
<tr>
<td>Greendale</td>
<td>Nearly level to strongly sloping.</td>
<td>Medium</td>
<td>Alluvium derived from uplands underlain mainly by noncalcareous sandstone and shale.</td>
</tr>
<tr>
<td>Leadville</td>
<td>do.</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Holston</td>
<td>do.</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Red Podzolic soils:</td>
<td>Rolling to steep.</td>
<td>do</td>
<td>Eluvium from weathering of calcareous sandstone.</td>
</tr>
<tr>
<td>Tellico</td>
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<td>Colluvium derived from uplands underlain mainly by noncalcareous sandstone.</td>
</tr>
<tr>
<td>Allen</td>
<td>Very gently sloping to very strongly sloping.</td>
<td>Medium to rapid</td>
<td>Alluvium derived from uplands underlain mainly by noncalcareous sandstone and shale.</td>
</tr>
<tr>
<td>Waynesboro</td>
<td>Gently sloping to very strongly sloping.</td>
<td>do</td>
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<tr>
<td><strong>INTRAZONAL SOILS</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Rendzina soils:</td>
<td>Gently rolling to steep.</td>
<td>Slow.</td>
<td>Eluvium from the weathering of limestone.</td>
</tr>
<tr>
<td>Tumbes</td>
<td></td>
<td></td>
<td>Colluvium derived from uplands underlain by limestone.</td>
</tr>
<tr>
<td>Half Bog soils:</td>
<td>Nearly level to sloping.</td>
<td>do.</td>
<td></td>
</tr>
<tr>
<td>Burgin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planosols:</td>
<td>Nearly level to gently sloping.</td>
<td>do.</td>
<td>Alluvium derived from uplands underlain mainly by noncalcareous sandstone and shale.</td>
</tr>
<tr>
<td>Monongahela</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Great soil group and series</td>
<td>Relief</td>
<td>Internal drainage</td>
<td>Parent material</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------</td>
<td>------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Lithosols and lithosolic Gray-Brown Podzolic soils:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chilhowie</td>
<td>Rolling to steep</td>
<td>Slow</td>
<td>Eluvium from the weathering of— Limestone, with thin layers of shaly and argillaceous material. Limestone and shale interstratified. Shale (purplish red), with thin beds of limestone at wide intervals. Shale, with thin widely separated beds of limestone. Calcareous shale, with thin beds of sandstone. Noncalcareous shale, with thin beds of sandstone. Noncalcareous sandstone, in some areas containing thin beds of noncalcareous shale. Noncalcareous sandstone, with some calcareous shale. Noncalcareous sandstone, the formation containing some noncalcareous shale; the rocks generally purplish red.</td>
</tr>
<tr>
<td>Westmoreland</td>
<td>Rolling to very steep</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Teas</td>
<td>Hilly to very steep</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Litz</td>
<td>Rolling to very steep</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Dandridge</td>
<td>Hilly to very steep</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Montevallo</td>
<td>Hilly to steep</td>
<td>do</td>
<td></td>
</tr>
<tr>
<td>Muskingum</td>
<td>Hilly and steep</td>
<td>Medium to rapid</td>
<td></td>
</tr>
<tr>
<td>Dekalb</td>
<td>Steep</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Lehew</td>
<td>Hilly to very steep</td>
<td>Medium to rapid</td>
<td></td>
</tr>
<tr>
<td>Alluvial soils:</td>
<td></td>
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</tr>
<tr>
<td>Pope</td>
<td>Nearly level to gently sloping</td>
<td>Medium</td>
<td>Noncalcareous sandstone and shale.</td>
</tr>
<tr>
<td>Philo</td>
<td>do</td>
<td>Slow to very slow</td>
<td>Do.</td>
</tr>
<tr>
<td>Lindside</td>
<td>Nearly level to very gently sloping</td>
<td>do</td>
<td>Limestone.</td>
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<tr>
<td>Melvin</td>
<td>do</td>
<td>Very slow</td>
<td>Do.</td>
</tr>
<tr>
<td>Atkins</td>
<td>Level or nearly level</td>
<td>do</td>
<td>Noncalcareous sandstone and shale.</td>
</tr>
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1 With glei subsoil.
MORPHOLOGY, MEMBER SERIES, AND REPRESENTATIVE PROFILE OF THE GREAT SOIL GROUPS
GRAY-BROWN PODZOLIC SOILS

Gray-Brown Podzolic soils are a zonal group of soils having a comparatively thin organic covering and organic-mineral layers over a grayish-brown leached A horizon that rests upon an illuvial B horizon. The soils are developed under deciduous forest in a temperate moist climate. They have a surface covering of leaf litter, usually of deciduous trees, a dark thin mild (only slightly or moderately acid) humus, somewhat mixed with mineral soil; a grayish-brown crumb-structured loamy A₁ horizon; and a light grayish-brown or grayish-yellow loamy A₂ horizon; a moderately heavy nut-structured yellowish-brown, brown, brownish-yellow, or reddish-brown B horizon, becoming lighter colored with depth. The total depth of the solum varies considerably but seldom exceeds 4 feet. Podzolization is the main process in the development of these soils. In this county the Gray-Brown Podzolic soils are in the Pisgah, Hagerstown, Dunmore, Frederick, Elliber, Lodi, Bolton, Carbo, Wellston, Hayter, Emory, Camp, and Sequatchie series.

The soil of the Pisgah series has been formed from the residuum of limestone of high calcic content. Bedrock underlies the profile at a variable depth, but outcrops are present locally. This soil has a brown friable moderately heavy A horizon, containing a fairly large quantity of organic matter, and a yellowish-brown friable B horizon to a depth of 32 inches or more.

Pisgah silt loam of about 4-percent slope in a pasture about 1½ miles northwest of Rye Cove Memorial School has the following profile:

A. 0 to 8 inches, brown friable mellow silt loam containing a few small yellowish-brown chert fragments and a moderate quantity of decomposed organic matter incorporated with the mineral material.
B. 8 to 35 inches, yellowish-brown friable crumbly silty clay or heavy silty clay loam, containing small light yellowish-brown chert fragments and many black mineral particles, some of which have broken down, causing very small brown spots.
C. 35 inches +, finely mingled yellowish-brown and dark reddish-brown friable crumbly silty clay loam, containing numerous dark-brown and black mineral particles and some yellowish-brown chert fragments ¼ to ½ inch in diameter.

A slightly heavier A horizon and a reddish-brown to brownish-red B horizon differentiate the soils of the Hagerstown series from those of the Pisgah. The Hagerstown C horizon has ocherous-yellow streaks and spots in a reddish-brown coloration. The Hagerstown soils contain little or no chert particles and are different from the Pisgah in this respect, probably because of differences in the composition of the parent rocks.

Hagerstown silt loam, rolling phase, in an orchard in Stanley Valley about 5 miles west of Weber City has a profile as follows:

A. 0 to 8 inches, brown friable silt loam.
B. 8 to 24 inches, reddish-brown to brownish-red silty clay, moderately friable when moist, sticky and plastic when wet; breaks into small irregularly shaped aggregates; contains many small black mineral concretions.
B₂. 24 to 40 inches, the material is similar to that of B, but more friable.
C. 40 inches +, fairly friable silty clay, splotched and mottled red, reddish brown, and ocherous yellow.
Soils of the Dunmore series differ from those of the Hagerstown in having a thinner and lighter brown A horizon and a less red B horizon. Their B horizon is somewhat tough, slightly plastic, and smooth and takes a high polish on a cut surface. The profile in places contains a few small fragments of chert. In Scott County the A horizon has been somewhat modified in most places by accelerated erosion, and only eroded phases are mapped.

The presence of chert fragments characterizes the soils of the Frederick series, the cherty types having a larger aggregate area than the noncherty. The chert fragments, which occur both on the surface and in the soil, range from 1/2 to 6 inches or more in diameter; are angular and hard; and comprise 20 to 50 percent of the soil mass. Locally, erosion has removed the A horizon, exposing reddish-yellow or reddish-brown material of the B horizon. These soils are associated with soils of the Hagerstown and Clarksville series.

The limestone that gives rise to the Frederick soils contains considerable insoluble material, especially chert and sand. The soils, which generally are on cherty ridges, are relatively thick, slightly to moderately erosive, and moderately cherty to very cherty. It is significant that these characteristics are associated with parent material derived from limestone containing a large quantity of insoluble matter, mainly silica. Hagerstown, Pisgah, Dunmore, and Frederick soils may be considered a chain of soils in which the insoluble material in the parent rock increases in transition from Hagerstown to Frederick. Coincident with this increase is generally an increase in chertiness, thickness of profile, and permeability; and a decrease in plant nutrients, cohesiveness, and erodibility. The greater quantity of insoluble material in the weathered bedrock under the Frederick apparently has produced a thicker layer of unconsolidated material than under the other soils of this chain. This layer seems to keep the bedrock from weathering rapidly and may partly explain the higher positions of the Frederick soils.

A profile of Frederick cherty silt loam with a slope of about 8 percent about one-half mile east of Nickelsville shows the following characteristics:

A. 0 to 1/4 inch, light-gray silt loam, containing a small quantity of organic matter.

B. 0 to 6 inches, light-brown or light grayish-brown friable silt loam. 6 to 11 inches, yellowish-brown friable heavy silt loam or light silty clay loam.

B. 11 to 34 inches, somewhat reddish-brown friable slightly tough and plastic silty clay; breaks easily into angular and subangular fragments 1/2 to 2 inches in diameter, and these with further pressure break into particles 1/4 to 1/2 inch in diameter; contains a few grayish-yellow and almost white chert fragments up to about 6 inches in diameter.

C. 34 inches +, mixed or streaked reddish-brown and ochreous-yellow friable silty clay or silty clay loam, having a reddish-brown coating and black mineral film on some of the breakage planes; contains some light-gray and light yellowish-gray chert fragments 1 to 3 inches in diameter.

Many light-gray chert fragments 1/2 to 6 inches in diameter are on the surface and in the surface layer.

The slightly darker colored and slightly less leached A horizon and possibly browner B horizon distinguish the soils of the Elliber series
from those of the Clarksville, a member of the Yellow Podzolic great soil group. They have been formed from the residuum of limestone or dolomitic limestone that contains more impurities, as chert, than the limestone giving rise to Hagerstown and Dunmore soils. The soils are porous throughout the profile in the areas that contain large quantities of chert fragments. Many light-gray and light-brown pieces of chert, up to about 5 inches in diameter, are on the surface and in the profile in most areas of the soils.

Soils of the Lodi series closely resemble those of the Dunmore but contain more sand. This difference results from the sand content of the parent material, which is derived from dolomitic limestone inter-stratified with sandstone. The A horizon is light brown and friable; the B horizon is yellowish brown to brownish yellow and friable to moderately friable; and the C horizon is mingled, streaked, or mottled brown, dark red, and ochreous yellow and friable. In Scott County many light-gray pieces of chert up to 6 inches in diameter are on the surface. There are also in places some brown and grayish-brown fragments of sandstone. Some chert fragments are mixed through the profile.

Residual material of weathered siliceous dolomitic limestone or of interstratified dolomitic limestone and sandstone gave rise to the soils of the Bolton series. They resemble the Hagerstown soils in the color of the A horizon but generally have a less red B horizon. They also have a fluffier and mellower A horizon and a somewhat more friable B horizon. They are generally on slopes that face north and east. Pieces of what apparently is iron-bearing mineral are on the surface in places, and such mineral probably contributed color to the soil. The A horizon contains a fairly large quantity of decomposed organic matter. Many small black mineral concretions or accretions are present, but mostly in the B and C horizons. Bedrock lies at considerable depth and is rarely exposed. The soils are associated on cherty ridges with Frederick and Clarksville soils but are practically free from chert. A few sandstone fragments up to 6 inches in diameter are scattered over the surface in some places.

Soils of the Carbo series differ from those of the Pisgah and Hagerstown series in having a brownish-yellow or yellowish-brown tough plastic B horizon, a shallower solum, and in being shallower over bedrock. They are derived from residual material of weathered argillaceous limestone.

Carbo silty clay loam, rolling phase, with a slope of about 8 percent, about 3 miles east of Snowflake, has the following profile:

A. 0 to 1 inch, grayish-brown friable heavy silt loam, containing a small quantity of organic matter.

A<sub>s</sub>. 1 to 6 inches, light-brown friable silty clay loam.

B<sub>s</sub>. 6 to 12 inches, brownish-yellow moderately friable plastic silty clay; breaks into angular fragments ⅛ to ⅛ inch in diameter; contains many small black mineral particles.

B<sub>s</sub>. 12 to 24 inches, yellowish-brown heavy tough plastic silty clay, breaking into angular lumps ⅛ to 2 inches in diameter, the breakage planes coated dark reddish brown; black mineral film and small black mineral particles are present to some extent, and some brownish material of the A horizon has infiltrated and collected on cleavage planes and in root casts.

C. 24 inches +, mingled brown, dark reddish-brown, and ochreous-yellow friable moderately plastic silty clay loam, containing some small greenish-yellow decomposed shale fragments, a few small black mineral particles, and some black mineral film.
Associated with soils of the Muskingum series in mountainous country, the Wellston soil occupies the hilly or very strongly sloping areas; the Muskingum the steep and very steep areas. It has been formed from residual material of weathered sandstone with an admixture of weathered shale in places.

Under virgin conditions, the A horizon is light yellowish brown or light brown about 8 inches thick, the first inch or two being light grayish brown because of a small accumulation of organic matter. The B horizon is light brown, friable, and about 18 inches thick; the C is of brownish-yellow friable crumbly decomposed sandstone intermixed with some sandstone fragments.

Soils of the Hayter series have developed from old colluvium and local alluvium. The material of the colluvium came from mountain slopes underlain mainly by noncalcareous sandstone. It consists of sandstone fragments and other rock debris, and probably some calcareous material in most places. The parent material has been in place long enough for the development of the characteristic profile of the normal Gray-Brown Podzolic soils of the region. Hayter soils differ from the Yellow Podzolic Jefferson soils, with which they are associated in some places, in being much browner throughout the profile and in containing much more decomposed organic matter. Sandstone fragments up to 10 inches in diameter are on the surface and mixed with the soil in many areas, and locally there are a few sandstone boulders.

Hayter loam with a slope of about 4 percent 1 mile east of Snowflake has the following profile:

A. 0 to 12 inches, brown mellow loam, light grayish brown when dry and dark brown when wet, and containing a moderate quantity of organic matter incorporated with the mineral matter.

B. 12 to 28 inches, slightly yellowish-brown friable silty clay loam; breaks into 2- to 3-inch lumps that are readily broken into aggregates ¼ to ½ inch in diameter and then easily crushed into a soft structureless mass; contains a few small black mineral particles distributed through the material.

C. 28 inches +, brown friable silty clay loam of slightly lighter texture and slightly more friable consistence than that in the B horizon, and containing soft shale particles and sandstone fragments up to 3 inches in diameter.

Associated with soils of the Hagerstown and Pisgah series, the soil of the Emory series has been formed from material washed mainly from these soils and deposited at the foot of slopes, along intermittent drainageways, and in depressions. These colluvial deposits are modified locally by alluvium, but have been in place long enough for a fairly definite profile to be developed in many places. The soil is almost level to strongly sloping and is well drained. It has developed under a deciduous forest and a climate similar to that under which Greendale and Leadvale soils have developed. The Emory soil occupies positions on the landscape similar to those occupied by the Yellow Podzolic Greendale and Leadvale soils and the Gray-Brown Podzolic Camp soils, but the soils of these four series have developed from parent materials of different character.

Emory silt loam in a very gently sloping grassed area about 1½ miles east of Mount Hagan School has the following profile:

A. 0 to 18 inches, brown friable silt loam, containing a moderate quantity of organic matter.
B. 18 to 34 inches, yellowish-brown friable silty clay loam, in which are some small black mineral particles.

C. 34 inches +, light yellowish-brown friable crumbly silty clay loam, slightly more friable than that in the B horizon and containing many small black mineral particles.

The mode of origin of the soils of the Camp series is similar to that of the Emory, but the color and general character of parent material is different. The A horizon of the Camp soils is purplish brown, friable, and about 10 inches thick; the B horizon light purplish-brown friable clay loam or silty clay loam about 24 inches thick; and the C horizon light purplish-brown very friable clay loam or silty clay loam, slightly lighter in color and texture than the B. Many purplish and yellowish soft shale particles are mixed with the material, which has been washed mainly from Upshur-Litz soils.

The soil of the Sequatchie series has developed from rather old alluvium consisting of materials washed from uplands underlain by noncalcareous sandstone and shale and in places limestone. It occupies positions on low terraces or high first bottoms near streams and is associated with Holston soils on the terraces and Pope soils on the adjacent stream bottoms. The Sequatchie soil is browner throughout than the Holston.

In this county the Sequatchie soil probably contains more brown and less red than those farther south. As the county is near the boundary between Red Podzolic and Gray-Brown Podzolic soils, the Sequatchie soil is placed in the Gray-Brown Podzolic great soil group.

This soil is pervious to water, and the parent material is naturally low in content of bases. The climate, vegetation, relief, and parent material were practically the same in the development of this soil as in that of the Red Podzolic Waynesboro soils. Its parent material, however, has been in place a much shorter time than that of the Waynesboro, and only a relatively young profile has developed.

The Sequatchie soil has a brown friable A horizon and light-brown or a yellowish-brown friable fine sandy clay B horizon. Its C horizon varies from place to place in texture and consistence; and water-worn siliceous rocks up to 8 inches in diameter are mixed through it.

YELLOW PODZOLIC SOILS

Yellow Podzolic soils are a zonal group having thin organic and organic-mineral layers over a grayish-yellow leached layer that rests on a yellow horizon. The soil-development processes are podzolization with some laterization. The Yellow Podzolic soils in the county are in the Clarksville, Jefferson, Greendale, Leadvale, and Holston series.10

These soils occupy nearly level to steep relief. The vegetation under which they developed consisted largely of deciduous trees and some small vegetation, but may not have been so dense as that under which the Red Podzolic soils developed. Climatic conditions on the soils of each group doubtless were quite similar. Some of the Yellow Podzolic soils are not so well drained in the lower part as the Red Podzolic.

10 In some places soils mapped with the soils of the Greendale and Leadvale series have practically no profile development and belong in the Alluvial soils great soil group.
The parent material of the Yellow Podzolic soils contains much siliceous material but it has a lower content of bases than that of the Red Podzolic. It is possible that the formation of the Yellow Podzolic soils was greatly affected by the character of the parent material.

Soils of the Clarksville series are on cherty ridges in limestone lowland belts. These soils are light-colored and cherty and are derived from residual material of weathered dolomitic limestone containing much chert and in places sandstone. They differ from the associated soils of the Frederick series in having a somewhat lighter colored and thicker A horizon and a brownish-yellow or yellow B horizon. The C horizon is mottled or mingled brown, rust-brown, ochreous-yellow, and light-gray friable silty clay loam. A great many light-gray hard angular chert fragments ¼ to 6 inches across are on the surface and throughout the profile in most areas, and in some localities the surface is almost completely covered.

Although the Clarksville soils resemble somewhat the soils of the Elliber series of the Gray-Brown Podzolic great soil group, they differ in having less organic matter in the A horizon and in being slightly yellower in the B.

The parent material of the Clarksville soils probably produces many of the effects on soil formation that parent material derived from weathered sandstone produces. The parent rock, a highly siliceous dolomitic limestone, is weathered to comparatively great depths, and the residuum has probably lost most of its content of bases. This residuum is strongly acid and has a low base-exchange capacity, indicating that siliceous matter is dominant in the parent material.

A thick eluvium protects the unweathered rock from geologic erosion and apparently partly accounts for the high positions that Clarksville soils occupy on the landscape and for the steepness of many of the slopes. These soils seem to be less erodible than other soils of the county developed from the residue of weathered limestone.

Soils of the Jefferson series are on foot slopes of mountains and have been formed from colluvium and local alluvium. The colluvium consists of sandstone fragments and other rock waste derived from mountainsides.

The Jefferson soils are associated with Allen and Hayter soils. They have a yellow B horizon; whereas the Allen and Hayter soils have red and brown B horizons, respectively. Although soils of these three series have been formed from the same general class of material, it is probable that calcareous materials influenced the formation of the Allen and Hayter soils, the former of the Red Podzolic group and the latter of the Gray-Brown Podzolic. In many places the Jefferson soils are characterized by light-gray and light-brown angular sandstone fragments up to 6 inches across, strewn over the surface and mixed through the profile.

The following profile description is of Jefferson fine sandy loam with a slope of about 6 percent in a forested area about 4 miles east of Gate City:

A. 0 to ½ inch, gray or brownish-gray light fine sandy loam, containing a small quantity of organic matter.
A1. ½ to 6 inches, grayish-yellow or slightly brownish-yellow friable fine sandy loam.
B. 6 to 30 inches, yellow or slightly brownish-yellow friable crumbly fine sandy clay, containing a few small sandstone fragments.

C. 30 inches +, mottled or streaked yellowish-brown, dark reddish-brown, ocherous-yellow, and light-gray very friable fine sandy clay, containing some small sandstone fragments.

Derived from material washed from Clarksville, Carbo, Frederick, and other light-colored soils, the soils of the Greendale series have developed near the base of slopes and in depressions. Although occupying positions on the landscape similar to those of the Emory soil, they are associated with different soils, and their parent material has a lower content of bases. They have developed under a climate similar to that under which the Emory soil has developed and under a forest of deciduous trees, but the stands and the undergrowth may have been thinner. The Greendale soils have a light-colored A horizon, a yellow or slightly brownish-yellow B horizon, and a mottled or splotched gray-and-brown C horizon.

Greendale silt loam with a slope of about 5 percent in grassland about one-half mile east of Beechgrove Church has profile characteristics as follows:

A. 0 to 8 inches, grayish-brown friable smooth silt loam.
B. 8 to 32 inches, yellow to brownish-yellow heavy friable crumbly silty clay loam, easily crushed into a fairly smooth mass; contains a few small round black concretions and in the lower part of the layer a few gray mottings.

C. 32 inches +, mottled brownish-yellow, light-gray, and brownish-red slightly compact heavy silty clay loam; breaks into fairly large brittle moderately friable lumps, rather easily crushed into small angular aggregates; contains small black and dark-brown concretions fairly easily crushed with the fingers.

Soils of the Leadvail series are developed at the base of slopes from local wash derived from soils on uplands underlain by noncalcareous sandstone and shale. They are similar in mode of occurrence, profile development, and color to the Greendale soils but differ in character of parent material.

Leadvale and Greendale soils have more advanced profile development than the Emory soil, but in some places the profiles are weakly developed. In many places the lower part of the profile is a compact gray layer, splotched or mottled brown or rust brown on the cleavage planes. This layer has probably been caused by some obstruction to the downward movement of moisture through the soil; and this retardation of soil drainage gives rise to a condition suggestive of an intrazonal soil. Further study may reveal these soils to be Planosols.

The soil of the Holston series is developed on stream terraces from old alluvium derived from uplands underlain mainly by noncalcareous sandstone and shale. It has a well-developed profile and is associated with soils of the Waynesboro series. This soil appears to be the oldest Yellow Podzolic soil in the county, and in some places its morphology approaches that of Planosols, or soils with an eluviated A horizon and a more strongly illuviated, cemented, or compacted B horizon than in the normal soils.

The Holston soil is derived from material having a low content of bases, a condition that has probably brought about rapid soil formation. Slightly impeded internal drainage also may have aided in bringing about the yellow color of the B horizon.
Holston fine sandy loam with a slope of about 4 percent about 1½ miles southwest of Dungannon has the following profile characteristics:

A. 0 to 8 inches, light-gray or light yellowish-gray friable fine sandy loam or mellow loam, containing very little organic matter.
B. 8 to 35 inches, yellow or slightly brownish-yellow friable fine sandy clay or very fine sandy clay.
C. 35 inches +, mottled brownish-yellow, rust-brown, and light-gray compact sandy clay, breaking into lumps easily crushed to a soft friable structureless mass.

RED PODZOLIC SOILS

Red Podzolic soils constitute a zonal group of soils having thin organic and organic-mineral layers over a yellowish-brown leached layer that rests on an illuvial red horizon; developed under a deciduous or mixed forest in a warm-temperate moist climate. The soil-forming processes involved in their development are laterization and podzolization.

In this county soils having common characteristics of Red Podzolic soils are members of the Tellico, Allen, and Waynesboro series. Apparently they have developed under similar climate and vegetation. They are well drained and, although ranging somewhat with respect to maturity, are old enough to have at least a moderately well-developed Red Podzolic profile. The slopes are gentle to very strong and the profiles are similar, but the character of the parent materials differs.

Soils of the Tellico series are on rolling to steep valley uplands, though the relief is dominantly hilly and steep. They are derived from the residuum of weathered gray, dark-gray, or purplish-gray calcareous sandstone. In many places the soils have a purplish hue, the color probably being derived from the parent rock.

Tellico very fine sandy loam, eroded phase, with a slope of about 8 percent in a slightly eroded area along United States Highway No. 58 about 4 miles southeast of Hilton has the following profile:

A. 0 to 5 inches, brown friable very fine sandy loam, having a purplish cast.
B. 5 to 24 inches, purplish-brown very friable crumbly heavy loam or light very fine sandy clay, containing some small soft decomposed sandstone fragments.
C. 24 inches +, light purplish-brown very friable mellow very fine sandy loam intermixed with yellowish-brown, reddish-brown, and ochreous-yellow soft crumbly decomposed sandstone still retaining the original structural lines.

A few purplish-brown sandstone fragments ½ to 6 inches across are on the surface.

The soil of the Allen series is associated with soils of the Jefferson and Hayter series. It has a red B horizon, the Jefferson soils yellow, and the Hayter soils brown. Soils of all three series are derived from similar parent material, consisting of colluvium derived from mountain slopes underlain mainly by noncalcareous sedimentary rocks. Local alluvium has contributed somewhat to their formation.

The Allen soil has developed under climate and vegetation similar to those under which the Waynesboro soils have developed. The parent material of the Allen soil permits moisture to move freely through the profile, and the content of bases is low enough for the
rapid development of a mature genetic profile. Parent material of 
this character should give rise to Yellow Podzolic soils, as in soils of 
the Jefferson series, but in the Allen series it has given rise to Red 
Podzolic soils. It is possible that the influence on this parent mate-
rial by material from calcareous rock or by water containing cal-
careous material has caused the development of Red Podzolic soils 
instead of Yellow Podzolic.

Allen fine sandy loam with a slope of about 8 percent in a wooded 
area about three-quarters mile south of Pattonsville has the following 
profile:

A. 0 to 1 inch, grayish-brown light fine sandy loam, containing a small quan-
tity of organic matter.

Aa. 1 to 6 inches, brown friable fine sandy loam, light grayish brown when 
dry.

B. 6 to 10 inches, light yellowish-brown friable heavy-textured fine sandy 
loam or light-textured fine sandy clay.

Bb. 10 to 38 inches, brownish-red friable fine sandy clay, sticky when wet.

C. 38 inches +, brownish-red or reddish-brown friable crumbly fine sandy 
clay, lighter in texture than the material of Bb.

A few light-gray angular fragments of sandstone 6 to 10 inches in 
diameter are on the surface and in the profile.

Soils of the Waynesboro series are on stream terraces, where they are 
associated with the Holston soil. The parent material in both series 
consists of alluvium derived from uplands underlain mainly by non-
calcareous sandstone and shale.

The Waynesboro soils are well-developed members of the Red Pod-
zolic great soil group. Their B horizon lacks the texture and con-
sistency of the B horizon common to Red Podzolic soils developed from 
materials of weathered limestone. The substrata are so pervious to 
water that they have not prevented thorough leaching of the soil mass. 
It is possible that the parent material, doubtless being low in content 
of bases and probably of other elements, permitted more rapid develop-
ment of a mature soil than the parent material of Hagerstown and 
Pisgah soils of the Gray-Brown Podzolic great soil group. It is also 
possible that the vegetative cover under which the Waynesboro soils 
developed was less luxuriant than that under which these soils de-
developed, and that a low supply of vegetable matter partly caused the 
lighter color of the A horizon in the Waynesboro soils.

Waynesboro fine sandy loam, sloping phase, near the North Fork 
Holston River about three-fourths mile south of Hilton has the fol-
lowing profile:

A. 0 to 8 inches, light grayish-brown, tinged yellow, loose open very friable 
fine sandy loam.

B. 8 to 18 inches, yellowish-brown very friable silty clay loam, containing 
a few small reddish-brown mottings; easily crushed into a friable mass in which yellow is more pronounced.

Bb. 18 to 35 inches, reddish-brown slightly brittle friable and crumbly silty 
clay loam, yellowish hue when crushed into a mass and breaking 
rather easily into small irregularly shaped aggregates.

C. 35 inches +, reddish-brown or brownish-red very fine sandy clay faintly 
mottled with yellow and olive; moderately hard in place but break-
ing readily into angular aggregates ¼ to ½ inch in diameter, brittle, 
friable, and easily crushed into a yellowish-red or yellowish-brown mass.

Below about 6 feet there are a fairly large number of water-worn 
rocks up to about 5 inches in diameter; a few are on the surface and 
mixed through the profile.
RENDZINA SOILS

Rendzina soils comprise an intrazonal group of soils, usually with a brown or black friable surface horizon underlain by light-gray or yellowish calcareous material developed under grass vegetation or mixed grasses and forest, in humid and semiarid regions, from relatively soft highly calcareous parent material. The soil-development process is calcification. In Scott County the only member of the Rendzina soils great soil group is in the Tumbez series.

The soil of this series is comparatively shallow, ranging in depth to bedrock from 8 to 15 inches. The parent material consists of almost white or grayish-purple limestone or dolomitic limestone. In most places the profile is calcareous throughout and effervesces freely with hydrochloric acid. The surface layer apparently contains a moderate quantity of organic matter.

Tumbez silty clay loam with about 8-percent slope in grassland south of Rye Cove Memorial School has the following profile:

1. 0 to 3 inches, dark-gray heavy silty clay loam, breaking into hard angular soil particles about ⅛ inch in diameter.
2. 3 to 10 inches, dark-gray or grayish-brown heavy silty clay, plastic when wet; breaks into angular and subangular aggregates ¼ to ½ inch in diameter.
3. 10 to 15 inches, gray heavy silty clay mixed with almost white soft decomposed limestone.
4. 15 inches +, gray, bluish-gray, and purple limestone rock.

HALF BOG SOILS

Half Bog soils constitute an intrazonal group with a mucky and peaty surface layer underlain by gray mineral soil, developed largely under swamp-forest types of vegetation, mostly in a humid or subhumid climate. Gleization is the soil-development process in their formation. In Scott County the Burgin series is included in the Half Bog great soil group and is represented by Burgin silty clay loam, which is on foot slopes in limestone belts, where it was formed from material washed mainly from Carbo soils.

Burgin silty clay loam with about a 5-percent slope in grassland in the vicinity of Mount Hagan School has the following profile:

1. 0 to 6 inches, dark-gray silty clay loam, containing small brown spots, forming when dry into distinct hard angular particles about ⅛ inch in diameter.
2. 6 to 24 inches, very dark gray silty clay, containing small rust-brown spots and some small black and dark-brown concretions; it is tough and tight, and when dry is hard.
3. 24 inches +, dark-gray, mingled or mottled with brown heavy plastic clay slowly permeable by water.

PLANOSOLS

Planosols constitute an intrazonal group of soils with an eluviated surface horizon underlain by a B horizon more strongly illuviated, cemented, or compacted than associated normal soils and has been developed on nearly flat upland surface under grass or forest vegetation in a humid or subhumid climate. Podzolization and gleization are the soil-development processes involved in their formation. In Scott County the Monongahela series is the only member of the Planosol great soil group. It is represented by the Monongahela fine sandy loam.
This soil is on terraces near streams and is associated with soils of the Holston series. It is similar to the Holston soils in the upper part, but at a depth of about 20 inches is mottled, rather heavy, friable, and plastic. Factors that brought about the development of the Monongahela profile are nearly level relief, imperfect drainage, and extreme age.

**LITHOSOLS AND LITHOSOLIC GRAY-BROWN PODZOLIC SOILS**

The Lithosols and lithosolic Gray-Brown Podzolic soils include immature soils thinly developed over rock formations under conditions of ample to excessive moisture. The parent materials in this group vary widely in composition, being derived from a great number of igneous, sedimentary, and metamorphic rocks. The soils naturally differ greatly in composition and productivity as a result of this variety of parent material and the differences in local conditions that govern the decomposition of rocks and the formation of soil. A comparatively small proportion of the land is cultivated.

In Scott County sedimentary rocks, consisting of limestone, sandstone, and shale, have given rise to members of this group. The land surface generally is hilly, steep, and very steep. The series represented are Chilhowie, Westmoreland, Teas, Litz, Dandridge, Montevallo, Muskingum, Dekalb, and Lehew.

In addition to soils of these series, the following six miscellaneous land types are mapped and placed in the group: Limestone rockland; Rolling stony land (limestone material); Rough gullied land (limestone and shale materials); Rough stony land (limestone material); Rough stony land (Muskingum soil material); and Sandstone rockland. The gullied land, caused by accelerated erosion, has been closely and deeply dissected and consists largely of rock material. The stony lands comprise outcrops of bedrock, some loose rock fragments, or both, and some soil or earthy material. In most places the slopes are rough and steep and almost prohibit soil formation. Limestone rockland and Sandstone rockland constitute 90 percent or more of outcrops of bedrock.

In the Lithosols and lithosolic Gray-Brown Podzolic group the soils are closely related to the rocks from which they are derived and in general have a very weak profile. On the more gentle slopes the profile of some of the soils more nearly approaches that of a member of the zonal soil order.

In most places soils of the Chilhowie, Litz, Dandridge, Montevallo, Muskingum, Dekalb, and Lehew series are shallow and consist essentially of an A horizon over parent material in various stages of decomposition, though in a few places a definite ABC profile exists. Soils of the Westmoreland and Teas series in many places are somewhat thicker over bedrock and in some places a weak ABC profile has developed. All these soils are designated as lithosolic Gray-Brown Podzolic soils to indicate that they are marginal between zonal and azonal soils, though in some places they are zonal.

Soils of the Chilhowie series range in thickness from a few inches to about 20 inches. In Scott County they are stony and are severely eroded. In uneroded areas the surface layer consists of dark grayish-brown or dark-gray rather heavy silty clay loam about 5 inches thick. The subsoil is yellowish-brown tough plastic silty clay about 15 inches
thick. Beneath this is mingled grayish-brown and gray tough somewhat plastic silty clay or clay mixed with limestone fragments.

The soils of the Westmoreland series are associated with Muskingum and Lehew soils on steep and very steep mountain slopes and with Carbo, Hagerstown, and other soils on hilly, steep, and very steep valley uplands. The Westmoreland soils have formed from weathered products of an interstratified limestone and shale formation, in which limestone composes the greater part in some places and shale in others. They vary somewhat in physical characteristics and thickness, depending largely on the character of the surface relief and parent rock. The unweathered rock underlies the soils at a depth ranging from about 1 foot to several feet, though bedrock crops out in a few places. The rock strata usually dip at various angles, though in some places they are nearly horizontal.

Westmoreland silt loam with a slope of about 32 percent in a pasture about 1 mile southeast of Nickelsville has the following profile:

A. 0 to 4 inches, grayish-brown friable silt loam, when dry light gray or light grayish-brown; a few small soft shale fragments on the surface and in the soil.

C. 4 to 12 inches, light yellowish-brown friable silty clay loam, containing a few small greenish and brownish soft shale fragments.

C₂. 12 inches +, soft decomposed greenish and brownish shale intermixed with light-brown and slightly reddish-brown friable silty clay loam, the soft shale still retaining its original structural lines, with black mineral film on the cleavage planes.

Soils of the Teas series have formed from weathered material of a rock formation consisting of purplish-red shale, greenish-yellow shale, thin strata of limestone, and possibly other calcareous material. The Teas soils seem to be derived mainly from the purplish-red shale of this mixed formation, and their dominantly purplish-red color apparently has been inherited from the parent rock. The soil profile is in an intermediate stage of development, and the soils vary somewhat in depth but in most places are comparatively shallow to bedrock. They have some characteristics of Lithosols, but are considered lithosolic Gray-Brown Podzolic soils. A relatively small total area is mapped as Teas silt loam and Teas silt loam, very steep phase. A large total area is mapped as a Teas-Litz complex; and a fairly large total area is in the Teas-Dandridge complex.

The surface layer of Teas silt loam is about 6 inches thick and consists of friable purplish-brown or grayish-brown silt loam. This is underlain by purplish-brown or purplish-red friable to fairly heavy silty clay loam or silty clay 9 to 15 inches thick, containing a few decomposed shale particles. Beneath this layer is the parent material of purplish-red or purplish-brown friable silty clay, containing decomposed shale fragments and in places sandstone fragments.

Soils of the Litz series are mapped in this county as Litz shaly silt loam and in the Teas-Litz complex. The dominant relief of the Litz soils is steep and very steep, and the soils are generally shallow to bedrock. They are derived from weathered material of a shale formation in which thin strata of limestone occur at wide intervals. Small thin shale fragments are on the surface and in the soil in many areas and make the soil shaly. In many places the soil consists only of a surface layer about 6 inches thick, which overlies soft decomposed shale or shale bedrock.
The surface layer of the Litz soils is light brown or grayish brown, friable, fine-textured, and 4 to 6 inches thick. This layer is underlain by light-brown or yellowish-brown friable silty clay or silty clay loam 4 to 15 inches thick, grading into brownish-yellow or greenish-yellow soft weathered shale. In some places the surface layer lies directly on the decomposed shale rock. Small soft shale fragments are on the surface and throughout the soil in many places.

Located on hilly, steep, and very steep valley uplands, the soils of the Dandridge series are associated with soils of the Teas, Carbo, Dunmore, and Frederick series. They have about the same depth as the Teas and Westmoreland soils and resemble Westmoreland soils in color profile. The Dandridge soils are derived mainly from calcareous shale. A relatively small total area is mapped in the Teas-Dandridge complex.

In the Dandridge profile the surface layer is grayish brown, brown, or light brown, fine-textured, and 3 to 6 inches thick. Beneath this is a layer 5 to 15 inches thick consisting of light-brown, brownish-yellow, or yellowish-brown friable silty clay loam, generally containing some small soft decomposed shale particles. This layer is underlain by a grayish-yellow and light brownish-yellow or brown, dark reddish-brown, and gray friable crumbly silty clay intermixed with many greenish-yellow, light-green, and reddish-brown decomposed shale particles.

Soils of the Montevallo series are associated with soils of the Muskingum series and are derived mainly from products of weathered noncalcareous shale. They occupy positions on foothills of mountains and have hilly and steep slopes. Many partly weathered shale chips are on the surface and in the soil, and the soils are shaly in most places.

The Montevallo soils are 6 to 14 inches in depth to partly weathered shale or shale rock. In some places a thin layer of light-brown or yellowish-brown silty clay loam lies between the 2- to 5-inch light grayish-brown to light yellowish-brown surface layer and the parent material; in others the surface layer grades into the parent material.

Soils of the Muskingum series are on mountains and are derived from weathered material of noncalcareous sandstone or interstratified noncalcareous sandstone and shale. In some places they are associated with soils of the Lehew and Westmoreland series. They generally have steep slopes and are comparatively shallow to bedrock. Light-brown angular sandstone fragments up to 6 inches in diameter are on the surface and mixed with the soil in most areas.

These soils may be considered skeletal, though there are indications of genetic morphology in places. The underlying rocks are resistant to weathering and the steep slopes favor geologic erosion, conditions that largely restrict the formation of genetic horizons. As the soils are closely related to the parent rock, they are considered to be lithosolic.

Muskingum very fine sandy loam on a steep slope in a forest about half a mile south of Hilton has the following profile:

A. 0 to 1 inch, dark-gray very fine sandy loam, containing a fairly large quantity of partly decayed organic matter.

A2. 1 to 5 inches, yellowish-gray loose open friable crumbly very fine sandy loam, containing a few small sandstone fragments.
C. 5 to 18 inches, grayish-yellow to light brownish-yellow heavy very fine sandy loam, containing decomposed sandstone and sandy shale fragments, most of which are brownish yellow but some gray and reddish brown; the material of this layer is very friable and crumbly.

C. 18 inches +, decomposing sandstone and sandy fragments intermixed with sandy soil material of a little darker color than in C; most of these rock fragments brownish yellow, but some reddish brown or brownish red.

In most places the soil of the Dekalb series is on steep slopes and is found on some of the highest parts of the Cumberland Plateau. It has dark-brown or dark grayish-brown surface layers in contrast with the lighter brown surface layers of the surrounding Muskingum soils. This soil is derived from weathered material of noncalcareous sandstone and in places weathered material of calcareous shale.

Dekalb loam in a fairly smooth forested area near Camp Rock in the northern part of the county has the following profile characteristics:

A. 0 to 6 inches, dark-brown or dark grayish-brown friable loam, containing considerable organic matter derived from decayed vegetation.

C. 6 to 28 inches, slightly yellowish-brown or light-brown very friable light-textured fine sandy clay or heavy-textured fine sandy loam; contains a few angular sandstone fragments, up to 6 inches in diameter.

C. 28 inches +, light-brown or yellowish-brown friable fine sandy clay intermixed with many sandstone fragments 4 to 6 inches in diameter.

The positions occupied by soil of the Lehew series are on very strong to very steep slopes of ridges and mountains. This soil is associated with soils of the Muskingum series and differs from them mainly in being purplish red. Brown angular sandstone fragments up to about 10 inches or more in diameter are on the surface and in the soil in many areas. These fragments are numerous enough to render the soil stony. Outcrops of bedrock appear here and there. The parent material is composed of weathered purplish-red sandstone and some purplish-red shale. The parent rock is noncalcareous in most places. The color of the soil seems to be inherited from the parent rock, though modified somewhat by soil-forming processes, especially in the surface layer.

Lehew stony very fine sandy loam with a slope of about 35 percent in a cultivated field on the south side of Stone Ridge about 2 miles southwest of Pattonsville has the following profile:

A. 0 to 8 inches, purplish-brown friable very fine sandy loam or fine sandy loam, light purplish brown when dry; in forested areas somewhat darker to a depth of about 1 inch because of an accumulation of a small quantity of organic matter.

C. 8 to 22 inches, purplish-brown to purplish-red friable, crumbly, heavy very fine sandy loam or loam.

C. 22 inches +, purplish-brown or purplish-red very friable very fine sandy loam or fine sandy loam, containing some decomposing fragments of purplish sandstone up to 6 inches or more in diameter.

Many brown hard, flat sandstone fragments 4 to 8 inches across are strewn over the surface, and a few are in the A and C. horizons.

**Alluvial Soils**

Alluvial soils are an azonal group of soils that have developed from transported and relatively recently deposited material (alluvium) characterized by little or no modification of the original material by
soil-forming processes. The Alluvial soils in this county are in the Pope, Philo, Lindside, Melvin, and Atkins series. Soils of the Melvin and Atkins series have glei layers, apparently caused by lack of drainage and aeration in the lower part of the profile.

The Alluvial soils are derived from first-bottom alluvium. They are young or very young, and profile development is poorly defined or almost lacking. New material is added to the soils when the streams overflow. Differentiation between the series is based largely on characteristics determined by composition of parent material and condition of drainage. Soils of the Melvin and Atkins series have some features common to soils of the Half Bog great soil group, or soils in which development is dominated by gleization, but lack the highly organic surface layers of Half Bog soils.

Soils of the Pope, Philo, and Atkins series constitute a catena in that they are derived from similar parent material, their differences being caused mainly by the condition of drainage. In this catena the Pope soil is well drained, the Philo imperfectly, and the Atkins poorly drained.

Included in this group, also, are Alluvial soils, undifferentiated; Stony alluvium (Pope soil material); and Riverwash. These miscellaneous land types are alluvium, colluvium, or both, in which very little or no soil development has taken place. They are true Lithosols.

From the surface downward the soils of the Pope series are brown, becoming slightly lighter in color with depth. In many places they are faintly mottled in the lower part of the profile. Some gravel is on the surface and through the profile, and gravel underlies the profile in places at a depth of 3 to 4 feet.

Pope fine sandy loam in a very gently sloping cultivated area along Staunton Creek has the following profile:

1. 0 to 12 inches, brown mellow fine sandy loam, light brown when dry.
2. 12 to 34 inches, light-brown friable crumbly heavy fine sandy loam.
3. 34 inches +, light-brown friable very fine sandy loam or fine sandy loam, containing a few faint brown spots.

The parent alluvium of the soil of the Philo series is similar in source and composition to that of Pope soils. Pope soils are generally brown throughout the profile; whereas the Philo soil is brown in the upper layer and mottled to various degrees with gray in the rest of the profile. The Philo soil varies somewhat in texture, especially in the lower layers. It is found in first bottoms near streams.

Philo fine sandy loam in a nearly level area near the North Fork Clinch River about 2 miles southwest of Pattonsville has the following profile:

1. 0 to 8 inches, brown friable mellow fine sandy loam.
2. 8 to 28 inches, mottled gray and brown friable heavy fine sandy loam.
3. 28 inches +, gray, mottled or spotted with rust brown, slightly plastic silty clay loam, containing an appreciable quantity of very fine sand, a few black specks, some black film, and some brown fibrous organic matter.

First-bottom alluvium, consisting of materials derived from uplands underlain mainly by limestone, gave rise to the soil of the Lindside series. This soil has a brown or light-brown friable fine-textured surface layer about 10 inches thick, grading into mingled or mottled moderately friable and slightly plastic loam or silty clay loam. At
a depth of about 28 inches this material gives way to mottled or splotted gray-and-brown compact loam, silt loam, or heavy plastic silty clay.

Lindside silt loam in a nearly level area of pasture land about 1 mile east of Gate City has a profile as follows:

1. 0 to 10 inches, brown friable silt loam, containing a few dark-brown spots.
2. 10 to 28 inches, slightly grayish-brown mottled or spotted with dark-brown friable slightly plastic silty clay loam, containing a few yellowish-brown chert particles 1/4 to 1/4 inch in diameter.
3. 28 inches +, mottled gray-and-brown heavy plastic silty clay or clay, containing a few yellowish-brown chert particles about 1/4 inch in diameter.

The soil of the Melvin series is derived from first-bottom alluvium washed from uplands underlain mainly by limestone. The surface layer is light gray with small brown spots, fine-textured, moderately plastic, and about 8 inches thick. A mottled or mingled gray-and-brown rather plastic silty clay underlies this layer, which grades into mottled gray-and-brown heavy plastic clay at a depth of about 28 inches. The profile in the lower part resembles Half Bog soils but lacks their highly organic A horizon. To indicate its resemblance to intrazonal soils it is here designated as Alluvial soil with glei layer.

Light colored and poorly drained throughout, the soil of the Atkins series is derived from first-bottom alluvium composed of material that came from uplands underlain by noncalcareous shale and sandstone. It has a glei layer and resembles Half Bog soils, except that it does not have a highly organic A horizon. To indicate its resemblance to intrazonal soils it is here designated as an Alluvial soil with glei layer.

Atkins fine sandy loam in a nearly level area about half a mile north-east of Hilton has the following profile:

1. 0 to 6 inches, gray, with small spots of light-brown and rust-brown, slightly plastic fine sandy loam.
2. 6 to 24 inches, mottled gray, light-brown, and rust-brown slightly plastic very fine sandy clay or silty clay.
3. 24 inches +, gray, mottled with light-brown and rust-brown plastic silty clay loam, containing some very fine sand. The water table is approximately at the top of this layer.
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