SOIL SURVEY

Carter County Tennessee

Series 1942, No. 4 Issued November, 1953

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
TENNESSEE AGRICULTURAL EXPERIMENT STATION
and the
TENNESSEE VALLEY AUTHORITY

How to Use THE SOIL SURVEY REPORT

FARMERS who have worked with their soils for a long time come to know about soil differences on their own farms and on those of their immediate neighbors. What they do not know, unless soil surveys have been made, is how nearly their soils are like those on 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 from soils so different that they could not hope to get yields as high, even if they followed the same practices. There is no way to find this out unless a soil survey has been made to show similarities and differences among soils. By knowing what kind of soil he has and comparing it with those on which new developments have proved successful, the farmer will remove some of the risk and uncertainty involved in trying new methods of production and new varieties of crops.

SOILS OF A PARTICULAR FARM

To learn what soils are on any farm or other tract of land, first find the area on the soil map, which is in the envelope inside the back cover. This is easily done by using roads, streams, villages, dwellings, and other features on the map to help locate boundaries.

Each kind of soil is marked on the map with a symbol; for example, areas marked JE have the same kind of soil. To find the name of the soil so marked, look at the legend printed near the margin of the map and find JE. The color indicated for JE in the legend is used also to indicate the soil on the map. JE stands for Jefferson gravelly loam, rolling phase. To find out what this soil is like, turn to the section on Descriptions of Soil Units and find Jefferson gravelly loam, rolling phase. There, following the name of the soil, will be found a statement of what this soil is like, what it is mainly used for, and some of the uses to which it is suited.

How productive is Jefferson gravelly loam, rolling phase? Look at table 27. Find Jefferson gravelly loam, rolling phase, in the left-hand column and read the yields given opposite it under the names of the different crops. This table also gives estimated yields for all the other soils mapped in the county, so that Jefferson gravelly loam, rolling phase, may be compared with them.

What are considered good uses and good management practices for Jefferson gravelly loam, rolling phase? Read what is said about this soil in the section on Descriptions of Soil Units. Look also at the section headed Use and Management of Important Groups of Soils. Here the soils suited to about the same uses and management practices are grouped together. Find the group that contains Jefferson gravelly loam, rolling phase. Read what is said about crops, crop rotations, liming, fertilizing, drainage, erosion-control methods, and other management practices for this group of soils. It will apply to Jefferson gravelly loam, rolling phase.

SOILS OF THE COUNTY AS A WHOLE

If a general idea of the soils of the county is wanted, read the introductory part of section on the Soils of Carter County, Their Use and Management. This tells about the principal soils in the county, where they are found, and how they are related to one another. At the same time study the soil map and notice how the different kinds of soils tend to be arranged in different parts of the county. These patterns are likely to be associated with well-recognized differences in type of farming, land use, and land-use problems.

A newcomer who considers purchasing a farm in the county will want to know about the climate; the types and sizes of farms; the principal farm products and how they are marketed; the kind and conditions of farm tenure; kinds of farm equipment and machinery; churches, roads, schools, and railroads; the availability of telephone and electric services and water supplies; the industries of the county; villages; and population characteristics. This information will be found in the sections on General Nature of the Area and on Additional Information about Carter County. Those 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 Carter County, Tenn., is a cooperative contribution from the—

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TENNESSEE VALLEY AUTHORITY

Series 1942, No. 4

Issued November, 1953

SOIL SURVEY OF CARTER COUNTY, TENNESSEE [1]

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

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[1] Revised by L. E. Odom, Tennessee Agricultural Experiment Station.

[1a] Division of Soil Survey was transferred to the Soil Conservation Service on Nov. 15, 1952.

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CARTER COUNTY is an industrial-agricultural region. Many rural families depend upon industry for part of their livelihood. The average farm had only 11 acres of cropped land in 1945, and the soils are not highly productive. If farmers are to make a fair living, they must use their small acreages with the greatest skill and efficiency. Soils must be used for the crops to which they are well suited; management practices must be chosen to get the most out of the various soils. To provide information on the best agricultural uses of the land this cooperative soil survey was made by the United States Department of Agriculture, the Tennessee Agricultural Experiment Station, and

the Tennessee Valley Authority. Field work was completed in 1942, and, unless otherwise specifically indicated, all statements in this report refer to conditions in the county at that time.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Carter County, located in the extreme northeastern part of Tennessee (fig. 1), joins North Carolina and is separated from the Virginia-

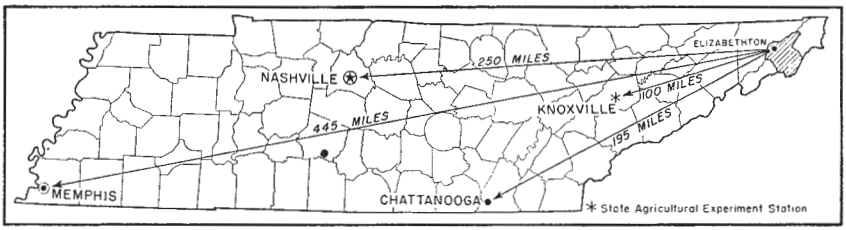

FIGURE 1.—Location of Carter County in Tennessee.

Tennessee boundary by one tier of counties. Elizabethton, the county seat, is 100 miles northeast of Knoxville and 250 miles east of Nashville. The county is bounded on the southeast by Avery and Mitchell Counties, N. C., on the southwest by Unicoi County, on the west by Washington County, on the northwest by Sullivan County, and on the north and northeast by Johnson County. Its total land area is 357 square miles, or 228,480 acres; in addition, the Watauga Reservoir covers 4,570 acres.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Physiographically, the county is partly in the Great Valley of the Valley and Ridge province and partly in the Unaka Mountains of the Blue Ridge province (fig. 2) (*6*).[2]

The Great Valley is not a river valley but merely a lowland belt paralleled by highland belts. Nearly all of it is underlain by sedimentary rock, limestone, shale, and sandstone, most of which have been folded and faulted. In this county limestone predominates, but both limestone and shale contents vary considerably from place to place. The limestone is chiefly dolomitic and contains much chert, but in some places it contains sand, chert and sand, or clay. Some of the shale is high in lime (calcium carbonate); the rest is generally acid. In most places, however, thin widely spaced layers of limestone are interbedded with the acid shale.

As a group, the rocks underlying the Great Valley are less resistant to weathering than those of either the Great Smoky Mountains to the southeast or of the Cumberland Plateau on the northwest. Because these rocks differ greatly from one another in resistance to weathering and because their folding and faulting is intense, the Great Valley is

[2] Italic numbers in parentheses refer to Literature Cited, p. 199.

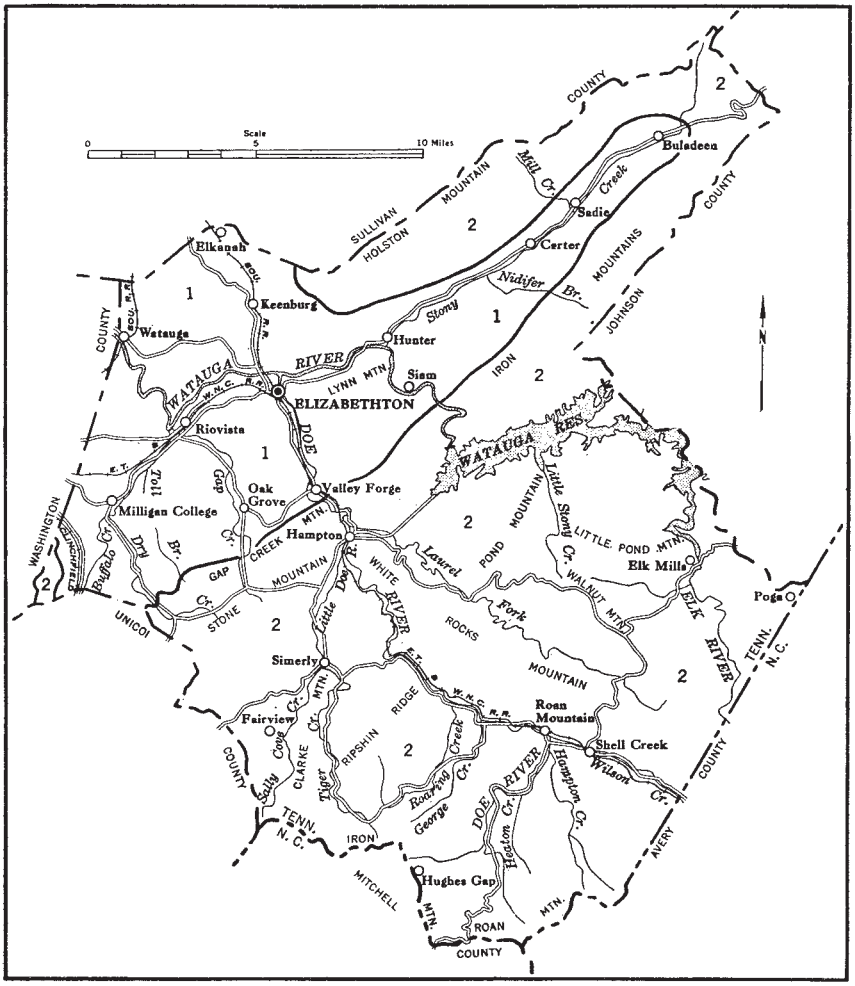

FIGURE 2.—Physiographic divisions of Carter County, Tenn.: (1) Great Valley of east Tennessee and (2) Unaka Mountains.

characterized by numerous parallel ridges and valleys. The more resistant rocks form the ridges and the less resistant ones the valleys; all run in a general southwest-northeast direction, parallel to the Great Valley.

The Unaka Mountain range, the crest of which forms the Tennessee-North Carolina State line, rises to altitudes of 2,500 to 6,300 feet above sea level and has many westwardly projecting spurs separated by steep narrow valleys (*2*). The rocks constituting this range are granite, gneiss, shale, slate, sandstone, conglomerate, and quartzite of the pre-Cambrian and Cambrian ages, and all have been faulted and folded. Owing to differences in the resistance of the rocks to weather-

ing and to the folding and faulting, the area is highly dissected and the relief is prevailingly steep and mountainous. Erosion of the softer and more soluble strata has left many valleys and coves, especially in the southeastern part of the county.

The relief of the Great Valley is prevailingly rolling and hilly, although it ranges from nearly level to steep. In most places the difference in elevation between the stream bottoms and the adjacent ridge crests ranges between 100 and 300 feet. Sinkholes characterize much of the landscape underlain by limestone, and a karst relief is characteristic of areas having numerous sinkholes.

The maximum difference in elevation within the county is almost 4,900 feet. Roan High Knob, elevation 6,313 feet,[3] is the highest point in the county. The quartzite mountains, Holston, Iron, and Gap Creek, range in elevation from about 2,500 to 4,332 feet. The granite and gneiss mountains are from 2,500 to almost 6,300 feet high. Elizabethton has an elevation of 1,532 feet; Hampton, 1,785 feet; Roan Mountain, 2,565 feet; Crabtree, 3,500 feet; and Hughes Gap, 4,040 feet.

Drainage in the Great Valley is by the Watauga River and its many tributaries. The topography of the area is greatly influenced by streams that rise in the mountains and flow across the valley before entering the Watauga. Small streams, many of them intermittent, are abundant nearly everywhere, especially in areas underlain by shale. Much water in areas underlain by limestone drains away through underground channels, and therefore these lands do not have so well-defined surface drainage patterns as those underlain by shale.

In the Unaka Mountain section drainage is well developed and has formed an irregular dendritic pattern in most places. This area is drained by the Watauga River and its tributaries—the Elk and Doe Rivers, Laurel Fork, and Stony, Little Stony, Sally Cove, Hampton, and Roaring Creeks. The major streams flow northwestward and have cut gaps in the mountain ranges in several places. The stream gradient is very steep, many of the streams falling from an elevation above 5,500 feet to about 1,500 feet.

CLIMATE

Carter County has a humid temperate climate (*14*), but owing to the great differences in elevation within the county, the Great Valley has hot summers and the mountain area has cool summers.[4] On an annual average, the mountain areas have about 12 inches more precipitation, 27 inches more snow, and 7° F. cooler mean temperature than the valley section. Fog and cloudiness are also greater, and the frost-free period shorter.

The data in table 1, from the records of the United States Weather Bureau station at Elizabethton, give a picture of temperature and precipitation conditions in the Great Valley part of the county; data from Banners Elk station in Avery County, N. C., show similar conditions in the mountain area. Climate in much of the county is probably intermediate between that at these two stations.

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[3] Elevations are from U. S. Geological Survey topographic maps.
[4] Classification of climate according to W. Koppen.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Elizabethton, Carter County, Tenn., and Banners Elk, Avery County, N. C.*

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snowfall
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Inches*
ELIZABETHTON, ELEVATION 1,532 FEET							
December	37.7	71	−12	3.52	1.11	1.50	1.8
January	37.9	76	−6	3.41	1.35	3.32	3.2
February	38.5	78	−17	3.10	1.16	1.80	3.3
Winter	38.0	78	−17	10.03	3.62	6.62	8.3
March	47.9	84	4	4.24	3.03	5.09	2.2
April	54.9	90	20	3.38	1.59	4.85	.7
May	65.2	94	28	4.09	1.02	6.98	0
Spring	56.0	94	4	11.71	5.64	16.92	2.9
June	72.5	102	40	4.79	5.50	8.76	0
July	75.7	104	48	4.75	6.71	2.62	0
August	75.0	98	45	4.92	1.24	7.76	0
Summer	74.4	104	40	14.46	13.45	19.14	0
September	69.0	98	30	3.21	2.92	7.61	0
October	57.3	90	22	2.76	1.19	6.08	.1
November	46.7	82	9	2.15	1.90	2.54	.8
Fall	57.7	98	9	8.12	6.01	16.23	.9
Year	56.5	104	−17	44.32	[1] 28.72	[2] 58.91	12.1
BANNERS ELK, ELEVATION 3,750 FEET							
December	34.5	75	−21	4.59	2.18	5.54	7.4
January	34.4	67	−13	3.72	3.37	8.65	8.6
February	34.4	72	−11	3.78	3.11	4.86	9.3
Winter	34.4	75	−21	12.09	8.66	19.05	25.3
March	40.6	82	−7	5.33	2.32	5.11	9.3
April	48.6	86	7	4.24	3.75	6.64	1.0
May	56.3	85	22	4.85	1.41	5.57	(3)
Spring	48.5	86	−7	14.42	7.48	17.32	10.3
June	63.4	88	27	5.37	6.62	5.67	0
July	66.4	95	35	6.26	2.31	7.60	0
August	65.7	94	31	5.85	.31	8.24	0
Summer	65.2	95	27	17.48	9.24	21.51	0
September	61.4	93	28	4.43	1.51	1.30	0
October	50.9	82	11	4.91	4.96	12.54	1.0
November	41.0	75	−7	2.60	4.20	1.23	2.4
Fall	51.1	93	−7	11.94	10.67	15.07	3.4
Year	49.8	95	−21	55.93	[4] 36.05	[5] 72.95	39.0

[1] In 1941. [2] In 1928. [3] Trace. [4] In 1925. [5] In 1908.

The rainfall is fairly well distributed throughout the year but slightly greater in summer and less in fall. Severe droughts are rare, although periods of deficient rainfall occur, especially in fall. Periods of excessive rainfall occur often, but most precipitation comes as light to medium-heavy rains. The rainfall is ample for even the most exacting crops of the region, but much of it is lost in runoff. Crop yields are sometimes materially reduced in the Great Valley area because of periods of light rainfall, especially on soils shallow to bedrock or otherwise droughty. Destructive hailstorms and tornadoes are infrequent.

Although no data on purely local variations in temperature and precipitation are available, many variations exist. Such variations can be explained by the lay of the land, including direction of slope, the effect of relief on air drainage, differences in elevation, and the proximity and relation to mountains. Frequently vegetation in the valleys and depressions is killed by frost when that on the ridges shows no injury. Early fall and late spring frosts are more injurious at the lower elevations. Frost injury to fruit trees is less frequent on ridge tops and north-facing slopes, as growth in spring is retarded in comparison with growth on south-facing slopes. Winterkilling of perennials, small grains, and other winter crops, owing to freezing and heaving, is more frequent on slopes characterized by seepage.

The average frost-free season in the Great Valley is 184 days, extending from April 19 to October 20. Frosts have occurred as late as May 15 and as early as September 30, but at such unusual dates they are seldom severe. The average frost-free season at Banners Elk is 148 days—from May 11 to October 6. The latest killing frost recorded at this mountain station occurred June 17, and the earliest, September 6.

The climate in the Great Valley is favorable for growing practically all common crops of the area. The frost-free season is ample for growing and maturing the important field crops. Perennial and winter-annual crops are successfully grown, especially on well-drained soils. In most years rainfall is adequate for high crop yields, except on the most droughty soils.

The cool summers of the mountain area, except possibly at the lowest altitudes, are especially favorable to late potatoes, cabbage, buckwheat, beans, and onions. Many pasture grasses do well, but the growing season is too short for such crops as cotton and sweetpotatoes. Late frosts in spring may injure many crops, especially fruits; and early frosts in fall sometimes damage late-maturing corn, tobacco, beans, and sorgo. Heaving of small grains by frost is usually much greater than in the Great Valley area, and the climate is too cold for winter vegetables.

WATER SUPPLY

The county is well supplied with water. Numerous perennial streams provide water for much of the permanent pasture, and intermittent streams furnish a considerable supply during seasons of heavy rainfall. Springs, common in both the mountains and the limestone valleys, are the main source of water for family use in the mountain area, whereas cisterns and wells are the principal sources in the Great Valley. Many farmers depend on springs or sinkholes that retain

water for livestock. Most springs are perennial. Where springs are intermittent, or the wet-weather type, farmers must haul water for livestock during dry periods.

VEGETATION

Practically all of the county was originally forested with hardwoods, mixed in places with hemlock, pine, fir, and spruce. The undergrowth consisted largely of rhododendron, mountain-laurel, hazelnut, huckleberry, and fern. At the time of survey about 65 percent of the county was still in forest, 74,000 acres of which were in the Cherokee National Forest. For a further discussion of vegetation see the section on Forests.

LAND USE

According to the 1945 census, 45.5 percent of the total area of the county was in farms. In 1944 about 26 percent of the farm land was in crops, about 35 percent in plowable pasture, and about 33 percent in woodland. The rest was used for miscellaneous purposes. The principal crops were corn, wheat, other small grains, and hay. Practically all of the county not in farms is forested.

ORGANIZATION AND POPULATION

The first known settlement in what is now Carter County was made on the Watauga River, near the present site of Elizabethton. Settlement began about 1769, but migration did not become general until about 1771 (*8*). In 1772 the Watagua Association was formed and became the first government in the locality. The area governed by this association was "the first place west of the Alleghenies where men joined together in a written compact for civil government and for the preservation of their ideals of liberty" (*10*). In 1772, an 8-year lease was made with the Cherokee Indians for "all country on the Watagua" (*8*), and in 1775 the first land was purchased from them. Carter County was formed from a part of Washington County in 1796 by the first legislature of the State of Tennessee.

The early settlers, chiefly of English, Scotch, or Irish descent, were mainly from North Carolina but included a small number from Virginia and South Carolina. The present inhabitants are largely descendants of these early settlers. The county has a population of 42,432 in 1950, 74.7 percent of which was rural. Elizabethton, the principal town and county seat, had a population of 10,754 in 1950.

THE SOILS OF CARTER COUNTY, THEIR USE AND MANAGEMENT

The soils of Carter County have developed in an environment of a moderately high temperature, a moderately heavy and well-distributed rainfall, and a forest vegetation. In such environment, the predominant soils, particularly those of the uplands, have been severely leached and are consequently acid in reaction and low in fertility, although they differ somewhat from one another. Practically all soils have formed under a forest vegetation, principally of hardwoods.

The soils differ greatly in color, texture, consistence, depth to underlying material, reaction, fertility, relief, stoniness, permeability, and drainage. All of these characteristics affect the productivity, workability, and conservability of the soils, and, accordingly, the agricultural uses to which they are suited.

The relief, or lay of the land, is important in determining suitability of the soil for agriculture because it affects ease of tillage, drainage and moisture relations, and erosion. Approximately 3 percent of the soils in the county are nearly level, 3 percent are undulating, 9 percent are rolling, 19 percent are hilly, 60 percent are steep, and 6 percent are very steep.

Drainage, which is closely related to relief, ranges from poor to excessive. Only a small acreage is poorly drained. The erosion hazard is important because relief is strong throughout most of the county. Many of the soils, however, are not highly erodible. About 73 percent of the area is virtually uneroded and 26 percent is moderately eroded; the rest is severely eroded.

About 29 percent of the soils are classed as nonstony; that is their topsoil does not contain enough stones to interfere materially with tillage. About 53 percent are classed as stony, cobbly, or gravelly and have a topsoil that contains enough stones to interfere with but not prohibit practical tillage. About 17 percent contain enough stone or bedrock outcrops to prohibit practical tillage, and about 1 percent consist essentially of rock outcrops with little or no soil present.

Texture and consistence range from loose incoherent sands to plastic clays. The surface soils, however, are predominantly loams or silt loams, whereas the subsoils are predominantly clay loams or silty clay loams.

Parent materials are important because they affect the recent, young, and immature soils that occupy much of the total area. The parent materials are mainly those weathered from several kinds of igneous and sedimentary rocks and the alluvium washed from the rocks. The kind of parent material influences fertility, degree of stoniness, depth to bedrock, and many other characteristics.

Less organic matter is added to a soil under forest than to one under grass vegetation; therefore, most of the soils are relatively low to medium in content of organic matter. They are relatively light colored except for a thin dark surface layer in undisturbed areas of forest where organic matter has accumulated. A few soil areas are darker and contain more organic matter because they are at high elevations where climate is colder, have grass instead of forest vegetation (as on the natural balds on mountaintops), have poor drainage, or are affected by other factors. In the virgin state the soils differ in fertility and content of organic matter, and these differences have been increased by cropping and erosion. In contrast to the soils of the uplands and high terraces (high benches), many soils of the bottoms and low terraces (second bottoms) are high in natural fertility. Many soils on high benches and second bottoms are well supplied with bases, including lime, and many are fairly well supplied with organic matter.

Differences in characteristics cause the soils to differ in their relative suitability for use in the present agriculture. Some are highly productive, easy to work and conserve, and therefore physically very well suited to agricultural uses. Others are low in productivity, difficult

to work and conserve, and therefore unsuited or very poorly suited to agricultural uses. Most of the soils, however, are between these two extremes. On the basis of differences in productivity, workability, and conservability, the soils have been grouped into five classes. Under ordinary systems of management common to the area, the First-, Second-, and Third-class soils are considered suitable for crops requiring tillage; Fourth-class soils are considered unsuitable or very poorly suitable for crops requiring tillage but are suitable for permanent pasture; and the Fifth-class soils are unsuitable or very poorly suitable for either crops or permanent pasture but are suitable for forest. These use classes are further discussed in the section on Interpretive Soil Groupings and Maps.

SOIL SERIES AND THEIR RELATIONS

On the basis of differences in characteristics the soils have been classified in 40 series. If full use is to be made of this soil survey, it is necessary to know the soils and to understand their relations. These relationships are more easily understood if the soils are placed in groups according to their topographic position. The soils of Carter County are placed in four main groups: (1) Soils of uplands, (2) soils of terrace lands, (3) soils of colluvial lands, and (4) soils of bottom lands.

The principal characteristics of the soil series of the county are shown in table 2.

TABLE 2.—*Principal characteristics of the soil series of Carter County, Tenn.*

SOILS OF UPLANDS

Soil series	Parent material	Relief	Drainage
	Sedimentary rocks:		
Decatur	High-gradelimestone	Rolling to steep	Good.
Dunmore	Slightly clayey dolomitic limestone.	do	Do.
Groseclose	Clayey dolomitic limestone.	Rolling to hilly	Do.
Fullerton	Dolomitic limestone	Rolling to steep	Do.
Clarksville	Cherty dolomitic limestone.	Rolling to hilly	Do.
Litz	Interbedded limestone and shale.	Rolling to steep	Excessive.
Teas	do	Hilly to very steep	Do.
Dandridge	Calcareous shale	Rolling to very steep	Do.
Ramsey	Quartzite, conglomerate, sandstone.	Hilly to very steep	Do.
Matney	do	Rolling	Good.
	Igneous rocks:		
Porters	Granite and gneiss (dark colored).	Hilly to very steep	Excessive.
Balfour	do	Rolling to hilly	Good.
Burton	do	do	Poor.[1]
Ashe	Granite and gneiss	Hilly to very steep	Excessive.
Perkinsville	do	Rolling to hilly	Good.

[1] Chiefly owing to seepage.

TABLE 2.—*Principal characteristics of the soil series of Carter County, Tenn.*—Continued

SOILS OF TERRACE LANDS

Soil series	Parent material	Relief	Drainage
	Old general alluvium (stream terraces):		
Hiwassee	Granite and gneiss (high terraces).	Undulating to hilly	Good.
Altavista	do	Nearly level to undulating.	Imperfect.
Roanoke	do	do	Poor.
Masada	do	Undulating to steep	Good.
State	Granite and gneiss (low terraces).	Nearly level to undulating.	Do.
Nolichucky	Sandstone and shale (high terraces).	Rolling to hilly	Do.
Holston	do	do	Do.
Sequatchie	Sandstone and shale (low terraces).	Undulating	Do.

SOILS OF COLLUVIAL LANDS

Soil series	Parent material	Relief	Drainage
	Local alluvium (local wash and some colluvial material):		
Allen	Sandstone and shale	Undulating to steep	Good.
Jefferson	do	do	Do.
Tusquitee	Granite and gneiss	Undulating to hilly	Do.
Tate	do	Rolling to hilly	Do.
Leadvale	Shale	Rolling	Do.
Camp	Limestone and purple shale.	Undulating to hilly	Do.
Hayter	Shale, sandstone, and limestone.	Undulating to rolling	Do.
Emory	High-grade limestone.	do	Do.
Ooltewah	do	Depressional	Imperfect.
Greendale	Cherty dolomitic limestone.	Undulating to rolling	Good.

SOILS OF BOTTOM LANDS

Soil series	Parent material	Relief	Drainage
	General alluvium (stream bottoms):		
Staser	Sandstone, quartzite, and shale.	Nearly level	Good.
Hamblen	do	do	Imperfect.
Lindside	Chiefly limestone	do	Do.
Buncombe	Granite and gneiss	do	Excessive.
Congaree	do	do	Good.
Chewacla	do	do	Imperfect.
Wehadkee	do	do	Poor.

SOILS OF UPLANDS

The upland soils are on high lands above the stream valleys. They have developed from materials residual from the weathering of the underlying rocks, and their properties are generally closely associated with the character of these underlying rocks. On the basis of differences in the kind of underlying material, the upland soils are placed in the following subgroups: (1) Soils derived from limestone, (2) soils derived chiefly from shale, (3) soils derived chiefly from quartzite, and (4) soils derived from granite and gneiss.

The miscellaneous land types of the uplands are areas that have no true soil and that have not been classed in series. They include Stony rough land (Porters and Ashe soil materials), Stony rolling land (Dunmore soil material), Stony rough land (Dunmore and Teas soil materials), Stony hilly land (Dunmore soil material), Stony rough land (Ramsey soil material), Limestone rockland, Quartzite and granite rockland, Rough gullied land (Ashe and Porters soil materials), Rough gullied land (Dandridge soil material), and Rough gullied land (Dunmore and Fullerton soil materials).

Soils Derived From Limestone

Although the Decatur, Dunmore, Groseclose, Fullerton, and Clarksville soils are all derived from limestone residuum, the parent rock varies from the high-grade limestone under the Decatur to cherty dolomitic limestone under the Fullerton and Clarksville. The Dunmore and Groseclose soils are derived from slightly clayey to clayey dolomitic limestone. The soils of this group are differentiated in the field largely by the color and texture of their surface soil and subsoil, although other significant differences exist.

Decatur soils have dark-brown or brown surface soil and dark-red or reddish-brown subsoil; Dunmore soils have grayish-brown surface soil and yellowish-red subsoil; and Fullerton soils have brownish-gray surface soil and yellowish-red or reddish-yellow subsoil. Fullerton soils further differ from the Dunmore in having a moderately plastic subsoil rather than a strongly plastic one. The Groseclose and Clarksville soils have gray friable surface soil and are differentiated chiefly on the basis of consistence and color of the subsoil. The Groseclose have yellowish-brown plastic subsoil; the Clarksville, yellow or brownish-yellow moderately plastic cherty subsoil.

Soils Derived Chiefly From Shale

The Dandridge, Teas, and Litz soils are characterized by numerous shale particles throughout the profile and shallow depth to bedrock. Although the soils are derived chiefly from shale, their parent rocks differ considerably.

The Dandridge soils are derived from the residuum of calcareous shale, whereas the Litz and Teas soils are derived from the residuum of interbedded limestone and shale. As the shale in the rock underlying the Teas soils is purple (known locally as red rock), those soils are readily identified by their purplish color. Litz soils have grayish-yellow surface soil and light brownish-yellow subsoil, whereas Dandridge soils have gray to yellowish-gray surface soil and yellowish-gray to brownish-yellow subsoil.

Soils Derived Chiefly From Quartzite

The Ramsey and Matney soils are developed on mountain slopes and ridge crests from the residuum of quartzite, conglomerate, sandstone, or slate. They differ chiefly in depth and degree of profile development. The Ramsey soils are mainly on steep slopes and have shallow weakly developed profiles; the Matney soil is chiefly on ridge crests and less steeply sloping areas and is a moderately deep soil with a well-developed profile. The Ramsey surface soil is pale brown to light yellowish-brown, and that of the Matney is yellowish gray to brownish gray. Both have light brownish-yellow subsoil.

Soils Derived From Granite and Gneiss

Members of the Ashe, Perkinsville, Porters, Balfour, and Burton series are derived from granite and gneiss. They are differentiated chiefly on the basis of depth to bedrock, degree of profile development, and color of surface soil and subsoil layers. The Perkinsville and Ashe are light-colored soils with brownish-gray or grayish-yellow surface soil and brownish-yellow or pale yellowish-brown subsoil. The Ashe are shallow excessively drained soils, occurring chiefly on steep slopes; the Perkinsville have heavier textured subsoil, are deeper to bedrock, and usually have less steep slopes than the Ashe.

The Porters and Balfour soils are darker than the Ashe and Perkinsville. The surface soil is grayish brown to brown, and the subsoil is yellowish brown. The Porters, like the Ashe, are shallow, excessively drained, weakly developed soils occurring chiefly on steep mountain slopes. The Balfour soils are on less steep slopes, have heavier textured subsoil, and are deeper to bedrock. The Burton soil is readily identified by a dark grayish-brown (almost black) surface layer very high in organic matter.

SOILS OF TERRACE LANDS

The present rivers and streams once flowed at considerably higher levels and at these levels deposited gravel, sand, and clay on their flood plains. Stream cutting over a great number of years has gradually deepened the channel; new flood plains were formed at the lower levels, but remnants of the older high-lying flood plains remained. These areas of general stream alluvium are now above the overflow stage of the present streams, and are referred to as terrace land, second bottoms, and benches. On the basis of differences in the origin of their parent materials the soils of the terraces are subdivided as soils derived from old alluvium chiefly from (1) granite and gneiss and (2) sandstone and shale.

Soils Derived From Old Alluvium Chiefly From Granite and Gneiss

The old alluvium from which Hiwassee, Masada, Altavista, Roanoke, and State soils developed has washed from uplands underlain chiefly by granite gneiss. Locally, however, there may be small quantities of materials from sandstone, quartzite, shale, slate, or even limestone.

The State is a brown well-drained soil confined to the low terraces, or second bottoms. The soils of the high terraces are differentiated chiefly on the basis of differences in drainage and color. The well-drained Hiwassee soils have brown surface soil and reddish-brown or red subsoil. The well-drained Masada have grayish-brown surface

soil and yellowish-brown subsoil. Although somewhat similar to the Masada soils in color, the Altavista soil differs in being imperfectly or moderately well drained. The poorly drained Roanoke soil is gray and mottled throughout the profile.

Soils Derived From Old Alluvium Chiefly From Sandstone and Shale

The Nolichucky, Holston, and Sequatchie soils are formed from old alluvium washed chiefly from uplands underlain by sandstone, shale, or quartzite. Locally the alluvium includes some material from granite, gneiss, and limestone.

The Holston and Nolichucky soils are on high terraces. The Sequatchie soils are similar to the State soils in color and position, their differences being largly due to those in the parent material. The Sequatchie soils are well drained and predominantly brown throughout the profile. The Nolichucky are well drained and have yellowish-gray surface soil and reddish-yellow or yellowish-red subsoil. The Holston soils are moderately well drained or well drained and have gray to yellowish-gray surface soil and yellow subsoil.

SOILS OF COLLUVIAL LANDS

Colluvial soils are along small drainageways, at the base of upland slopes, particularly the longer slopes on which erosion has been active, and on small sloping alluvial-colluvial fans where the small streams have made deposits on the broad flood plains of larger streams. Their parent materials are derived from soil materials and rock fragments washed and rolled from adjacent slopes. Four subgroups have been established on the basis of differences in origin of parent material: Soils derived from local alluvium or colluvium chiefly from (1) limestone, (2) sandstone and shale, (3) shale, and (4) granite and gneiss.

Soils Derived From Local Alluvium or Colluvium Chiefly From Limestone

The Emory, Greendale, and Ooltewah soils are derived from local alluvium or colluvium coming chiefly from limestone. The Emory soils are well drained and predominantly brown throughout. They are formed from material washed chiefly from Decatur and Dunmore soils—soils relatively free of chert, gravel, or stone. The Greendale soils are derived chiefly from material washed from the lighter colored soils, such as the Clarksville, Groseclose, and Fullerton. They have grayish-brown or brownish-gray surface soil and brownish-yellow subsoil mottled in most places at a depth of 20 to 30 inches. The Ooltewah soil, occurring in imperfectly drained depressional areas or swales, is grayish brown to depths of 16 to 20 inches, below which it is mottled gray.

Soils Derived From Local Alluvium of Colluvium Chiefly From Sandstone and Shale

The Hayter, Allen, and Jefferson soils are derived from local alluvium or colluvium, chiefly from sandstone, shale, and quartzite. The Hayter and Allen soils are influenced to some extent by limestone material. Hayter soils have grayish-brown surface soil and yellowish-brown subsoil. Allen soils have grayish-brown surface soil and yellowish-red to brownish-red subsoil. Jefferson soils have yellowish-gray surface soil and grayish-yellow to brownish-yellow subsoil.

Soils Derived From Local Alluvium or Colluvium Chiefly From Shale

The Leadvale and Camp soils are derived from local alluvium or colluvium coming chiefly from shale. Numerous shale fragments are found throughout their profiles. The parent material of the Camp soils has washed from Teas soils of the uplands and is readily identified by the purplish color. The material forming Leadvale soil is derived chiefly from Dandridge soils of the uplands. The Leadvale soil has yellowish-gray or brownish-gray surface soil and brownish-yellow subsoil.

Soils Derived from Local Alluvium of Colluvium Chiefly From Granite and Gneiss

The Tusquitee and Tate soils and Stony colluvium (Tusquitee and Jefferson soil materials) are derived from local alluvium or colluvium coming chiefly from granite and gneiss. Their parent material has washed mainly from Porters and Ashe soils of the uplands. Stones occur throughout the soils and in many places are numerous enough to interfere with tillage.

The Tusquitee soils are well drained and predominantly brown throughout the profile. They resemble the Porters and Balfour soils in color, having brown or grayish-brown surface soil and yellowish-brown subsoil. The Tate soils are lighter colored and, in general, less well drained than the Tusquitee. They resemble the Ashe and Perkinsville soils in color; the surface soil is light brown to grayish brown and the subsoil is light yellowish brown to yellow. Gray splotches may appear at a depth of about 20 inches. The stony colluvium land type is similar in many respects to the Tusquitee and Jefferson soils but differs chiefly in that it contains sufficient stones to prohibit feasible tillage.

SOILS OF BOTTOM LANDS

Bottom land refers to the flood plains or those nearly level areas along the streams that are subject to floods. The material giving rise to the bottom land soils has been carried by the streams. Its character depends largely upon its source in the higher lying lands and the rate at which the water was moving when the material was deposited. The material has not been in place long enough for well-defined surface soil and subsoil layers, such as are found in most upland and terrace soils, to develop. On the basis of differences in parent material this group is subdivided into soils derived from alluvium chiefly from (1) limestone, (2) sandstone and shale, and (3) granite and gneiss.

Soils Derived From Alluvium Chiefly From Limestone

The Lindside soil, the only member of this group, has formed from imperfectly drained general stream alluvium washed chiefly from upland soils, such as the Decatur, Dunmore, Fullerton, Groseclose, and Clarksville. Locally, the alluvium may contain some sandstone or shale material. The soil is light brown or grayish brown to depths of 12 to 18 inches; the lower layers are highly mottled with gray and brown.

Soils Derived From Alluvium Chiefly From Sandstone and Shale

The alluvium from which the Staser and Hamblen soils and Cobbly alluvium (Hamblen soil material) are formed has washed from such upland soils as the Ramsey, Dandridge, Teas, and Litz. The differences in the soils are chiefly due to drainage. The Staser soils are well drained and predominantly brown throughout the profile. The Hamblen soils are imperfectly drained and brownish gray to grayish brown, splotched with gray, brown, and yellow below 12 to 20 inches. Cobbly alluvium (Hamblen soil material) is similar in drainage to the Hamblen soils, but it contains sufficient cobblestones and gravel in the plow layer to prohibit feasible tillage.

Soils Derived From Alluvium Chiefly From Granite and Gneiss

Soils of the Buncombe, Congaree, Chewacla, and Wehadkee series are derived from alluvium chiefly from granite and gneiss. They have formed from material washed from upland soils, such as the Porters, Ashe, Perkinsville, and Balfour. Differences in them are closely associated with drainage. All have a sandy texture ranging from loamy sand (in the Buncombe soil) to loam. Some areas of these soils contain considerable gravel, but not enough to interfere with cultivation.

The excessively drained Buncombe soil is brownish yellow; the well-drained Congaree soils are predominantly brown throughout the profile; the imperfectly drained Chewacla soils are grayish brown highly mottled with gray and brown below a depth of 12 to 20 inches; and the poorly drained Wehadkee soils are predominantly gray throughout the profile.

DESCRIPTIONS OF SOIL UNITS

In the following pages the soils are described in detail, and their present use and management, use suitability, and management requirements are discussed. The symbol that identifies the soil area on the map follows the soil name. The distribution of the soils is shown on the accompanying soil map, and their acreage and proportionate extent are given in table 3.

Table 3.—*Acreage and proportionate extent of the soils mapped in Carter County, Tenn.*

Soil	Acres	Percent
Allen loam:		
Eroded rolling phase	824	0. 4
Rolling phase	159	. 1
Undulating phase	104	(1)
Allen stony loam:		
Eroded hilly phase	3, 111	1. 4
Eroded rolling phase	1, 940	. 8
Eroded steep phase	1. 389	. 6
Hilly phase	1, 054	. 5
Steep phase	1, 824	. 8

[1] Less than 0. 1 percent.

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TABLE 3.—*Acreage and proportionate extent of the soils mapped in Carter County, Tenn.*—Continued

Soil	Acres	Percent
Altavista silt loam	220	0.1
Ashe loam:		
Eroded steep phase	2,550	1.1
Steep phase	1,195	.5
Ashe sandy loam:		
Eroded hilly phase	201	.1
Eroded steep phase	352	.2
Hilly phase	281	.1
Steep phase	883	.4
Ashe stony loam:		
Eroded hilly phase	803	.4
Eroded steep phase	5,927	2.6
Hilly phase	1,416	.6
Steep phase	21,648	9.4
Very steep phase	1,130	.5
Balfour loam:		
Hilly phase	673	.3
Rolling phase	181	.1
Buncombe loamy fine sand	400	.2
Burton stony loam	503	.2
Camp silt loam:		
Hilly phase	88	(1)
Rolling phase	512	.2
Undulating phase	217	.1
Camp stony silt loam, rolling phase	187	.1
Chewacla fine sandy loam	698	.3
Chewacla gravelly fine sandy loam	633	.3
Clarksville cherty silt loam:		
Eroded hilly phase	675	.3
Eroded rolling phase	309	.1
Hilly phase	271	.1
Cobbly alluvium (Hamblen soil material)	1,587	.7
Congaree fine sandy loam	1,828	.8
Congaree loam	274	.1
Dandridge shaly silt loam:		
Eroded hilly phase	838	.4
Eroded rolling phase	217	.1
Eroded steep phase	2,291	1.0
Hilly phase	233	.1
Steep phase	2,039	.9
Very steep phase	964	.4
Decatur silty clay loam:		
Eroded hilly phase	859	.4
Eroded rolling phase	249	.1
Eroded steep phase	462	.2
Severely eroded hilly phase	114	(1)
Severely eroded steep phase	103	(1)
Dunmore silt loam:		
Hilly phase	177	.1
Steep phase	253	.1
Dunmore silty clay loam:		
Eroded hilly phase	1,698	.7
Eroded rolling phase	1,307	.6
Eroded steep phase	402	.2
Severely eroded hilly phase	295	.1
Severely eroded steep phase	165	.1
Emory silt loam:		
Rolling phase	151	.1
Undulating phase	124	.1

[1] Less than 0.1 percent.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Carter County, Tenn.*—Continued

Soil	Acres	Percent
Fullerton loam:		
Eroded hilly phase	1, 004	0. 4
Eroded rolling phase	625	. 3
Eroded steep phase	372	. 2
Hilly phase	191	. 1
Fullerton silt loam:		
Eroded hilly phase	1, 708	. 7
Eroded rolling phase	1, 092	. 5
Eroded steep phase	769	. 3
Hilly phase	261	. 1
Steep phase	482	. 2
Fullerton silty clay loam, severely eroded hilly phase	466	. 2
Greendale silt loam:		
Rolling phase	1, 185	. 5
Undulating phase	434	. 2
Groseclose silt loam:		
Eroded hilly phase	331	. 1
Eroded rolling phase	271	. 1
Hamblen loam	1, 054	. 5
Hayter loam:		
Rolling phase	137	. 1
Undulating phase	181	. 1
Hayter stony loam:		
Rolling phase	211	. 1
Undulating phase	161	. 1
Hiwassee clay loam:		
Eroded hilly phase	361	. 2
Eroded rolling phase	576	. 3
Eroded undulating phase	207	. 1
Holston cobbly fine sandy loam:		
Eroded hilly phase	199	. 1
Eroded rolling phase	292	. 1
Holston fine sandy loam, eroded rolling phase	157	. 1
Jefferson fine sandy loam, eroded rolling phase	184	. 1
Jefferson gravelly loam:		
Eroded hilly phase	288	. 1
Eroded rolling phase	671	. 3
Eroded undulating phase	279	. 1
Rolling phase	191	. 1
Jefferson stony fine sandy loam:		
Eroded hilly phase	1, 468	. 6
Eroded rolling phase	1, 165	. 5
Eroded steep phase	408	. 2
Hilly phase	1, 903	. 8
Rolling phase	633	. 3
Steep phase	1, 346	. 6
Undulating phase	199	. 1
Leadvale silt loam	181	. 1
Limestone rockland	141	. 1
Lindside silt loam	231	. 1
Masada gravelly silt loam:		
Eroded hilly phase	635	. 3
Eroded rolling phase	462	. 2
Eroded steep phase	146	. 1
Undulating phase	175	. 1
Masada silt loam:		
Eroded rolling phase	646	. 3
Undulating phase	1, 768	. 8
Matney loam, rolling phase	172	. 1

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Carter County, Tenn.*—Continued

Soil	Acres	Percent
Nolichucky fine sandy loam:		
Eroded hilly phase	533	0.2
Eroded rolling phase	859	.4
Ooltewah silt loam	101	(1)
Perkinsville loam:		
Eroded hilly phase	1,336	.6
Eroded rolling phase	391	.2
Hilly phase	684	.3
Rolling phase	211	.1
Porters loam, eroded steep phase	1,329	.6
Porters stony loam:		
Eroded hilly phase	442	.2
Eroded steep phase	4,882	2.1
Hilly phase	1,024	.4
Steep phase	12,445	5.4
Very steep phase	1,919	.8
Quartzite and granite rockland	2,088	.9
Ramsey stony fine sandy loam:		
Hilly phase	703	.3
Steep phase	33,722	14.7
Very steep phase	9,997	4.4
Roanoke silt loam	249	.1
Rough gullied land:		
Ashe and Porter soil materials	151	.1
Dandridge soil material	90	(1)
Dunmore and Fullerton soil materials	285	.1
Sequatchie gravelly loam	1,269	.6
Sequatchie loam	507	.2
Staser fine sandy loam	181	.1
State loam	464	.2
Stony colluvium (Tusquitee and Jefferson soil materials)	4,471	2.0
Stony hilly land (Dunmore soil material)	5,103	2.2
Stony rolling land (Dunmore soil material)	382	.2
Stony rough land:		
Dunmore and Teas soil materials	4,863	2.1
Porters and Ashe soil materials	14,224	6.1
Ramsey soil material	8,647	3.8
Tate loam:		
Hilly phase	261	.1
Rolling phase	363	.2
Teas-Litz shaly silt loams:		
Steep phases	4,098	1.8
Very steep phases	302	.1
Teas-Litz shaly silty clay loams:		
Eroded hilly phases	1,119	.5
Eroded steep phases	2,551	1.1
Teas-Litz silt loams, hilly phases	493	.2
Teas-Litz silty clay loams, eroded rolling phases	249	.1
Teas shaly silt loam:		
Hilly phase	191	.1
Steep phase	2,210	1.0
Very steep phase	225	.1
Teas shaly silty clay loam:		
Eroded hilly phase	473	.2
Eroded steep phase	2,099	.9
Tusquitee loam:		
Eroded hilly phase	744	.3
Rolling phase	1,177	.5
Undulating phase	221	.1

[1] Less than 0.1 percent.

TABLE 3.—*Acreage and proportionate extent of the soils mapped in Carter County, Tenn.*—Continued

Soil	Acres	Percent
Tusquitee stony loam:		
Hilly phase	1,476	0.6
Rolling phase	1,034	.5
Wehadkee loam	635	.3
Total	[2] 228,480	100.0

[2] This figure does not include 4,570 acres inundated by the Watauga Reservoir.

Allen loam, undulating phase (Ac).—This colluvial soil is on smooth areas of 2- to 7-percent gradient. The soil material is partly colluvial and partly alluvial; it lies at the base of the steep mountain slopes from which it was washed or is spread over the adjacent valley floor. The parent material has washed largely from uplands underlain by quartzite and slate but includes a slight admixture of material washed from lands underlain by limestone. Limestone or calcareous shale is generally at a depth of 3 feet or more. Surface runoff and subsurface drainage are moderate. Areas are small and occur in association with Jefferson, Sequatchie, Hayter, Decatur, Dunmore, and other Allen soils.

Profile description:

0 to 10 inches, grayish-brown to brown friable loam; 8 to 14 inches thick; surface inch under virgin conditions stained dark with organic matter.
10 to 18 inches, yellowish-red friable light clay loam; 4 to 12 inches thick.
18 to 40 inches, red to brownish-red moderately friable sandy clay or sandy clay loam; moderately well developed medium nut structure; 20 to 30 inches thick.
40 inches +, light-red to yellowish-red friable sandy clay loam streaked and splotched locally with yellow and gray; bedrock at depths of 3 to 15 feet.

The soil is medium to strongly acid and contains a moderate quantity of organic matter and plant nutrients. A few small semiangular sandstone or quartzite fragments may be scattered over the surface and through the soil mass, but not in numbers sufficient to interfere with tillage. The soil is sufficiently friable for easy penetration of plant roots and normal circulation of air and moisture. Rainfall is readily absorbed, and moisture is well retained. Accelerated erosion has removed 20 to 50 percent of the original surface soil on some steeper areas. Conservation, workability, and erosion control are not difficult.

As mapped, this soil includes areas showing a gradual transition from shallow colluvial material over limestone residuum (Decatur or Dunmore soil materials) to deep colluvial material that gives rise to typical Allen soils. This transition occurs on long fingerlike smooth-topped ridges that extend from mountain slopes into intervening valleys at right angles to the stream course. Such areas occur in Stony Creek valley. Typical Allen soils are on the ridges near the heads of the major valley. Downstream from these valley heads, however, the colluvial material on the tips of the ridges nearest the

major stream is shallow and mixed with limestone material. Decatur or Dunmore soils may be found on the extreme tips of the ridges. Approaching the ridge tip from the mountains, the surface layer of the soil becomes darker and the soil becomes heavier throughout. This soil grades toward the Decatur or Dunmore near the stream and toward Allen stony loam soils near the mountains.

Use and management.[5]—All of Allen loam, undulating phase, has been cleared and cultivated. About 20 percent is in corn, 15 percent in small grains, 40 percent in hay, 15 percent in pasture, and 10 percent in other crops. Usually crops are not rotated systematically, but some farmers use 3- and 4-year rotations of corn, small grains, hay, and pasture.

This soil is well suited to the general field crops of the county. It can be used intensively for intertilled crops if adequately limed and fertilized. Better management practice includes wider use of adapted crop rotations, increased use of lime and phosphate or high analysis fertilizer, growing of winter cover crops, and increased acreage of legume hay.

Allen loam, rolling phase (Ab).—This well-drained partly colluvial, partly alluvial soil is characterized by a brown surface soil and a red subsoil. It is at the base of the steep mountain slopes, from which the soil material washed, or is spread over the adjacent valley floor. The parent material has washed largely from uplands underlain by quartzite and slate but includes a slight admixture of material washed from lands underlain by limestone. Limestone or calcareous shale generally is at depths of 3 feet or more. This phase differs from the undulating phase chiefly in having stronger slopes (7 to 15 percent). The small scattered areas are associated with Jefferson, Sequatchie, Hayter, Decatur, Dunmore, and other Allen soils.

The soil is medium to strongly acid and contains a moderate quantity of organic matter and plant nutrients. A few small semiangular sandstone or quartzite fragments may be scattered over the surface and through the soil mass, but they do not interfere with tillage. The soil is sufficiently friable for easy plant-root penetration and normal circulation of moisture. Rainfall is readily absorbed and well retained.

Included with this soil are small areas that resemble the associated Hayter, Jefferson, and Sequatchie soils and also soils that are intermediate between these and Allen loam, rolling phase.

Use and management.—About 75 percent of Allen loam, rolling phase, has the forest cover that follows incomplete timber harvest. Most cleared and cultivated areas have been materially injured by accelerated erosion. The use of the cleared areas and the prevailing tillage, crop rotation, fertilization, and crop yields are similar to those for the eroded rolling phase.

Allen loam, eroded rolling phase (Aa).—The sloping areas of this colluvial soil extend out from the steep mountain slopes underlain by quartzite and slate. Surface runoff is moderately rapid, and internal drainage is moderate. Much of the surface soil has been lost as a result of erosion. Mixing of remnants of the surface soil with the subsoil has resulted in a plow layer highly variable in both color

[5] For further discussion of use and management, see the section on Use and Management of Important Groups of Soils.

and texture. This soil differs from the rolling phase chiefly in the degree to which it is eroded. Relatively small areas of this phase are widely distributed in association with Decatur, Dunmore, Hayter, Jefferson, Sequatchie, and other Allen soils.

Profile description:

0 to 6 inches, grayish-brown to brownish-yellow friable loam; 0 to 10 inches thick.

6 to 12 inches, yellowish-red friable light clay loam; 4 to 12 inches thick.

12 to 36 inches, red to brownish-red moderately friable sandy clay or sandy clay loam having a moderately well developed medium nut structure; 20 to 30 inches thick.

36 inches +, light-red to yellowish-red friable sandy clay loam streaked and splotched with yellow and gray in some places; bedrock at 3 to 15 feet.

The soil is medium to strongly acid, moderate in content of plant nutrients, and low in content of organic matter. A few small fragments of sandstone or quartzite may be scattered over the surface and through the soil, but they do not interfere with tillage. The soil is sufficiently friable for easy penetration of plant roots and normal circulation of air and moisture. Rainfall is readily absorbed, and moisture is well retained.

As mapped, this soil includes areas in which there is a gradual transition from shallow colluvial material over limestone residuum derived from Decatur and Dunmore soils to deep colluvial material that gives rise to the typical Allen soils. The soil grades toward Decatur or Dunmore soils near the streams and toward Allen stony loam soils near the mountains. Small areas are also included that resemble the associated Hayter and Jefferson soils and soils that are intermediate between them and Allen loam, eroded rolling phase. Small severely eroded spots having a clay loam texture are common and conspicuous because subsoil has been exposed.

Use and management.—All of the eroded rolling phase of Allen loam has been cleared and cultivated. Under cultivation, much of the original surface soil has been lost by accelerated erosion. The result has been loss of organic matter, more droughtiness, susceptibility to further erosion, lower content of plant nutrients, and lower productivity of most crops. About 20 percent of the phase is in corn, 15 percent in small grains, 35 percent in hay, 20 percent in pasture, and 10 percent in miscellaneous crops. Four-year rotations of corn, small grain, hay, and pasture are used by some farmers, but this is not a common practice. Under prevailing management practices, corn yields about 25 bushels an acre; wheat, 9 bushels; tobacco, 825 pounds; and red clover, 1.1 tons of hay.

This soil is well suited to the general field crops of the area but is deficient in lime, phosphate, nitrogen, and potash for many crops. Good tilth is easily maintained, and erosion control is not a serious problem. Better land-management practices include increased use of lime and phosphate or high analysis fertilizer, the growing of winter cover crops, and using increased acreages for legume hay (preferably red or alsike clovers).

Allen stony loam, eroded rolling phase (AE).—This well-drained soil occupies 7- to 15-percent slopes extending out from the steep mountain slopes. The colluvial deposits are spread over the adjacent valley floor or at the bases of the slopes from which they were

washed. The parent material comes largely from uplands underlain by quartzite and slate but includes a slight admixture of material washed from uplands underlain by limestone. Limestone or less calcareous shale is usually at a depth of 3 feet or more. The soil is widely distributed northwest of the Iron Mountains, except in the shale hill section in the extreme northwestern part of the county. The small areas are associated with Jefferson, Sequatchie, Hayter, Decatur, and Dunmore soils.

Profile description:

0 to 6 inches, grayish-brown to brownish-yellow friable stony loam; in virgin areas a thin surface layer is stained dark with organic matter.
6 to 14 inches, yellowish-red or yellowish-brown friable light stony clay loam.
14 to 36 inches, red to brownish-red moderately friable sandy clay or sandy clay loam having a moderately well developed medium nut structure.
36 inches +, light-red to yellowish-red friable stony sandy clay loam streaked and splotched with yellow and gray in some places.

The soil is medium to strongly acid, contains a moderate quantity of organic matter and plant nutrients, and is permeable enough for easy plant root penetration and normal circulation of air and moisture. Rainfall is readily absorbed and well retained. The few to many 2- to 8-inch semiangular sandstone or quartzite fragments on the surface and through the soil usually interfere with tillage or make it infeasible.

In many areas much of the original surface layer has been lost as a result of erosion; consequently, the present surface layer varies greatly in thickness, color, and texture. There may be no surface layer, or it may be up to 10 inches thick. The texture is heavier in many places because subsoil has been mixed with the plow layer. Small severely eroded spots are common and conspicuous because the red subsoil has been exposed.

As mapped, this soil includes areas in which there is a gradual transition from shallow colluvial material over limestone residuum of Decatur and Dunmore soils to deep colluvial material that gives rise to the typical Allen soils. Ridges most typical of this condition are in the Stony Creek valley and east of Keenburg. In many places the colluvial material on the tips of the ridges nearest the major stream is shallow over the limestone residuum and more mixed with limestone material. The ridge tops in some places have as little as a foot of colluvial material over limestone residuum. The soil from the shallow colluvium is darker and heavier.

Another variation is in the hilly area, some distance from the mountains, near Green Pine School. There, the colluvial material is shallow (18 to 42 inches thick) over limestone residuum of Fullerton or Dunmore soil materials, and the heavy red subsoil is moderately plastic. Other variations include small areas that resemble the associated Hayter, Jefferson, and Sequatchie soils, or are intermediate between them and the eroded rolling phase of Allen stony loam.

Use and management.—An estimated 90 percent of the eroded rolling phase of Allen stony loam has been cleared and cultivated. On the cultivated areas accelerated erosion has removed 25 to 75 percent of the original surface soil, and on a few acres practically all of it has been lost. With the loss of the original surface soil there has been a loss of organic matter, an increase in droughtiness, greater susceptability to further erosion, a loss of plant nutrients, and a decrease of

productivity. About 20 percent of the cleared land is in corn, 10 percent in wheat, 8 percent in other small grains, 35 percent in hay, 20 percent in pasture, and the rest in miscellaneous crops.

A 4-year rotation of corn, small grains, hay, and pasture is commonly used on the better farms, but on a large part of the soil crops are not systematically rotated or fertilized. Under common management practices, corn yields about 20 bushels an acre; wheat, 8 bushels; tobacco, 600 pounds; and red clover, 1.0 ton of hay.

The soil is only moderately well suited to crops requiring tillage. It is moderately difficult to conserve and deficient in lime, nitrogen, and phosphate for most crops. All improved management programs should include increased use of lime and phosphate or high analysis fertilizer, the growing of winter cover crops, use of longer rotations, and planting an increased acreage of legume hay crops and legume-grass pasture mixtures.

Allen stony loam, hilly phase (AG).—This well-drained soil of the colluvial lands occurs at the base of steep mountain slopes underlain by quartzite and slate. It consists of partly colluvial and partly alluvial material. The parent material has washed largely from Ramsey soils but is influenced by material from soils such as the Decatur and Dunmore. The colluvial deposits are largely underlain by limestone or calcareous shale. This soil differs from the eroded rolling phase in having stronger slopes (15 to 30 percent), in being uneroded, and in being more variable—usually shallower—in depth to bedrock. Areas are distributed throughout the part of the county north of the Iron Mountains that is underlain by limestone. The Jefferson, Hayter, Sequatchie, Dunmore, and Decatur are closely associated soils.

Profile description:

0 to 10 inches, grayish-brown to brown friable stony loam; the surface 1 to 2 inches is dark gray in virgin areas.
10 to 14 inches, yellowish-red friable light stony clay loam.
14 to 30 inches, red to brownish-red moderately friable stony sandy clay loam.
30 inches +, light-red to yellowish-red friable sandy clay loam, streaked and splotched with yellow and gray in most places.

The soil is medium to strongly acid, contains a moderate quantity of organic matter, and is permeable to roots, air, and moisture. Rainfall is well absorbed and well retained, although surface runoff is rapid. The 2- to 8-inch semiangular sandstone or quartzite fragments on the surface and through the soil mass usually interfere with tillage, and, in some places, make it infeasible.

This phase includes areas showing a gradual transition from deep colluvial deposits to shallow colluvial deposits over limestone material of Decatur, Dunmore, or Fullerton soils. This variation, however, is a small part of the total soil area. The shallow colluvium is usually 18 to 42 inches deep over limestone material, and the soil derived from it has a heavy moderately plastic red subsoil. Other variations are small areas resembling the associated Hayter, Jefferson, and Sequatchie soils and areas intermediate between those soils and Allen stony loam, hilly phase.

Use and management.—All of Allen stony loam, hilly phase, is under the forest cover that follows an incomplete timber harvest. Much

of this land is considered suitable for permanent pasture, but owing to poor workability and susceptibility to erosion it is not suitable for intertilled crops. Newly cleared land, if used for pasture, should be seeded to a legume-grass mixture to prevent serious loss of soil by accelerated erosion. Permanent pasture receiving no amendments should produce a low yield of fair quality pasture, but lime and phosphate are generally needed at the time of seeding to insure a good stand.

Allen stony loam, eroded hilly phase (AD).—This well-drained soil of the colluvial lands has a brownish-yellow surface soil and a red subsoil. It is on 15- to 30-percent slopes extending out from steep mountain slopes underlain by quartzite and slate. Its soil materials are partly colluvial and partly alluvial. From 50 to 75 percent, and in some areas practically all, of the original surface soil has been lost by accelerated erosion.

This soil differs from the hilly phase chiefly in the degree to which it has been eroded, but it is also lower in organic matter and plant nutrients, has a slightly heavier surface layer, is more droughty and more susceptible to further damage by accelerated erosion, and is less productive of most crops. Areas occur throughout that part of the county north of the Iron Mountains that is underlain by limestone.

Variations in depth to underlying material are great. Where the soil is shallow over limestone (18 to 42 inches) it is generally darker and heavier. Along sharp breaks in 1/8- to 1/2-acre areas, limestone soil material may be exposed, and Fullerton or Dunmore subsoil materials constitute the surface. Other variations include small areas that resemble the associated Hayter, Jefferson, and Sequatchie soils or are intermediate between them and this eroded hilly phase.

Use and management.—All of the eroded hilly phase of Allen stony loam has been cleared and cultivated—about 15 percent is in corn, 5 percent in wheat, 5 percent in other small grains, 20 percent in hay, 35 percent in pasture, and 20 percent is idle. No definite system of crop rotation is consistently followed; the land may remain in hay for 1 or 2 years and in pasture 1 to 5 years. Under prevailing management practices, corn produces about 10 bushels an acre; wheat, 5 bushels; and red clover, 0.8 ton of hay.

This soil is not well suited to crops requiring tillage but is suited to permanent pasture. Permanent pasture without amendments, however, gives low yields of low quality; lime and phosphate are generally required to insure a satisfactory stand and high yields. Under a high level of management, including adequate applications of lime and fertilizer, it may be feasible to use the less sloping areas for close-growing crops such as small grains and hay.

Allen stony loam, steep phase (AH).—Areas of this phase occupy 30- to 60-percent slopes extending out from mountains underlain by quartzite and slate. The soil material is largely colluvial, most of the parent material being from Ramsey soils. Drainage is good to excessive. This soil differs from the hilly phase chiefly in relief, in more variable profile characteristics, and in its indistinct surface soil and subsoil layers. The surface soil is dark grayish brown, and the subsoil red. Areas are widely distributed northwest of the Iron Mountains in close association with Jefferson, Hayter, and Ramsey soils.

Reaction is strongly acid, and the quantity of organic matter contained is small. A few to many 2- to 8-inch semiangular sandstone and quartzite fragments are on the surface and through the soil mass. They are sufficiently numerous to interfere with tillage and, in some places, to make it infeasible. In many places the soil contains a few boulders over 12 inches in cross section. The soil is sufficiently permeable for easy penetration of plant roots and circulation of air and moisture. Rainfall is readily absorbed and well retained, although runoff is excessive because of the steep slopes.

This soil includes small areas of the associated Jefferson and Ramsey soils. Soils intermediate between this unit and the Jefferson and Ramsey soils are also included.

Use and management.—All of Allen stony loam, steep phase, is under the forest cover that follows incomplete harvesting of timber. Its present use, for forest, is considered best, owing to steepness and stoniness. Under a high level of management, including moderate to heavy applications of lime and phosphate, productivity could probably be maintained under permanent pasture.

Allen stony loam, eroded steep phase (AF).—A brownish-yellow surface soil and red subsoil characterize this soil. It occupies steep slopes extending out from the mountains underlain by quartzite and slate. The soil materials are largely colluvial. Surface runoff is very rapid, and internal drainage is moderate to rapid. About 50 to 75 percent of the original surface soil has been removed by accelerated erosion; in a few small areas practically all of it has been lost. This phase differs from the steep phase chiefly in being eroded, but in addition it is lower in organic matter and plant nutrients, has a slightly heavier surface layer, is more droughty, and is more susceptible to further damage by erosion. Areas are widely distributed in the section underlain by limestone northwest of the Iron Mountains. The Ramsey, Jefferson, Hayter, and Dunmore are closely associated soils.

The soil is strongly acid. Numerous 2- to 8-inch sandstone and quartzite fragments on the surface and throughout the soil mass would interfere with tillage if it were otherwise feasible. The soil is very permeable and permits easy movement of air, roots, and water.

Use and management.—Steepness and stoniness make Allen stony loam, eroded steep phase, difficult to work with farm machinery. Erosion is difficult to control, and loss of soil material results in loss of fertility and productive capacity for most crops. Because the soil is difficult to work, difficult to conserve, and low in productivity for the common crops of the area, it is considered best suited to forest. Under some conditions, however, it may be advisable to use the milder slopes for pasture. The soil probably can be maintained in pasture under a high level of management, including moderate to heavy applications of lime and phosphate and carefully controlled grazing.

Altavista silt loam (AK).—This soil occupies 2-to 7-percent slopes on nearly level stream terraces of the Watauga and Doe Rivers and Wilson Creek. The terraces are 20 to 60 feet above the present flood plain. The small widely scattered areas are associated chiefly with Masada and Roanoke soils of terrace lands and Congaree and Chewacla soils of bottom lands. Surface runoff and internal drainage are moderately slow. The parent material from which this soil is formed

washed largely from soils underlain by granite, although in most places it contains material washed from soils underlain by sandstone, quartzite, shale, and slate. Calcareous shale or granite is at depths of 5 to 20 feet.

Profile description:

0 to 10 inches, grayish-yellow to brownish-yellow friable silt loam.
10 to 14 inches, yellowish-brown friable heavy silt loam.
14 to 30 inches, brownish-yellow to yellow moderately friable silty clay loam having a weakly developed medium nut structure and splotches of gray and brown in the lower part.
30 inches +, pale-yellow friable silty clay loam highly mottled with gray and brown.

This medium to strongly acid soil is moderately well supplied with organic matter and plant nutrients. It is virtually gravel- and cobble-free; in places gravel and cobblestones are scattered over the surface and through the profile but not in numbers sufficient to interfere materially with tillage. The soil is easily permeated by plant roots, air, and moisture.

The soil varies considerably from place to place in the loss of material through accelerated erosion. On many of the more sloping areas as much as 20 to 35 percent of the original surface soil has been lost. In such areas there has been some mixing of surface soil and subsoil in the plow layer, but in most areas the plow layer consists entirely of the original surface layer. Included are small areas of the associated Masada and Roanoke soils and soils that are intermediate between them and this Altavista soil.

Use and management.—All of Altavista silt loam has been cleared and cultivated. About 25 percent is in corn, 10 percent in wheat, 10 percent in other small grains including oats and barley, 30 percent in hay, 15 percent in pasture, and 10 percent in other crops or idle. The more progressive farmers commonly use 3- and 4-year rotations of corn, small grains, hay, and pasture; but on much of the soil systematic crop rotation is not practiced. Under common management practices these acre yields are normally expectable: Corn, 30 bushels; wheat, 14 bushels; tobacco, 1,400 pounds; and red clover, 1.1 tons of hay.

The soil is suited to most common field crops of the county, but poorly suited to deep-rooted crops or to crops sensitive to slow internal drainage. It is deficient in lime, nitrogen, phosphate, and probably potash for high yields of most crops, but it responds when these elements are added and other good management is practiced. Better management practices include an increased use of lime and phosphate, seeding of winter cover crops (crimson clover or small grains), and planting an increased acreage to legume hay crops.

Ashe loam, steep phase (Am).—This soil has developed on 30- to 60-percent slopes from the residuum of micaceous light-colored granite or gneiss. It differs from Porters soils principally in being more yellow and less brown, and from Perkinsville soils in being steeper. Areas are small, irregularly shaped, and widely distributed throughout the southeastern part of the county, chiefly in the Ashe-Tusquitee-Perkinsville soil association. Surface runoff is very rapid, and internal drainage is rapid.

Profile description:

0 to 10 inches, grayish-yellow friable loam; in wooded areas the surface 2 inches is loose dark grayish brown.
10 to 30 inches, pale yellowish-brown friable somewhat gritty heavy loam.
30 inches +, variegated brownish-gray to dark-gray, pale-yellow, and light yellowish-brown loam and partly disintegrated rock; bedrock at depths varying from 2 to 5 feet.

The soil is medium to strongly acid and low in organic matter and water-holding capacity. It is porous and friable and therefore easily permeable to plant roots, air, and moisture. A few stones and an occasional bedrock outcrop occur but do not interfere with tillage.

The boundaries between this soil and other soils of the mountains are not distinct, and small areas of associated soils are included. Areas of Porters loam soil and soils intermediate between it and this steep phase, are included, as well as small areas of Ashe sandy loam and Ashe stony loam soils.

Use and management.—All of the steep phase of Ashe loam is in forest that follows incomplete harvesting of timber. Part of it is within the boundaries of the Cherokee National Forest. Because of the steep slopes, difficulty of controlling runoff and erosion and conserving fertility, and general inaccessibility, forest is considered the best use on most farms. Under a high level of management, including moderate to heavy applications of lime and phosphate and carefully controlled grazing, permanent pasture probably can be maintained.

Ashe loam, eroded steep phase (AL).—This light-colored excessively drained soil of steep mountain slopes has developed from residuum of granite and gneiss. About 25 to 75 percent of the original surface soil has been removed, and in some areas all of it has been lost by accelerated erosion. The phase has been cleared of its native forest. It differs from Ashe loam, steep phase, in being eroded, and from Ashe stony loam, eroded steep phase, in being nearly free of stone. Areas are irregularly shaped and occur in close association with Ashe stony loam, steep phase, throughout the areas underlain by granite.

Owing to erosion, the present surface soil is variable in thickness and color. The thin dark surface layer of higher organic-matter content has been removed by erosion or mixed with other layers in the plow layer. The present surface soil is grayish yellow to yellowish brown and 2 to 10 inches thick.

The soil is strongly acid; low in content of organic matter, plant nutrients, and water-holding capacity; and very permeable to roots, air, and water. A few stones and an occasional bedrock outcrop occur, but not in quantities sufficient to interfere with tillage if tillage is otherwise feasible.

This phase, as mapped, includes small areas of associated soils, such as Porters and other Ashe soils. Some areas are also included that differ chiefly in having a reddish subsoil.

Use and management.—Ashe loam, eroded steep phase, is cleared and used for the staple crops common to the area. About 10 percent is in corn; 5 percent in small grains, including buckwheat; 5 percent in miscellaneous crops, including cabbage and green beans for market; 20 percent in hay, including lespedeza; 25 percent in pasture; and 35 percent is idle.

The steep slopes limit the use of farm machinery, encourage runoff and erosion, and make conservation difficult. This soil is best suited to forest; however, under some conditions it might be practical to use parts of it, especially the milder slopes, for pasture (pl. 1, *A*). Moderate to heavy applications of lime and phosphate are required to insure a satisfactory pasture, and grazing should be carefully controlled. With proper application of lime and phosphate, the soil produces good mixed grass-and-legume pasture.

Ashe sandy loam, steep phase (Ar).—Areas of this soil have developed on 30- to 60-percent slopes from the residuum of light-colored granite. The soil is widely distributed throughout the southeastern part of the county in close association with Porters, Perkinsville, and other Ashe soils. External and internal drainage are both rapid to very rapid. This soil differs from Ashe loam, steep phase, chiefly in being sandier throughout the profile.

Profile description:

0 to 10 inches, grayish-yellow friable sandy loam; in wooded areas the 2-inch surface layer is loose dark grayish-brown sandy loam.
10 to 30 inches, brownish-yellow or pale yellowish-brown friable heavy sandy loam.
30 inches +, highly mottled sandy loam and partly disintegrated rock; bedrock at depths varying from 2 to 5 feet.

The entire profile is medium to strongly acid, and the content of organic matter is low except in the dark surface layer under virgin conditions. The soil is very permeable to air, roots, and water. In most places, a few rock fragments are on and in the soil, and bedrock outcrops in places. Stoniness, however, does not interfere with tillage.

Boundaries between the Ashe soils and other soils of the mountains are indistinct, and small areas of associated soils are included. Included with this soil are small areas of Porters soils; soils intermediate between this soil and Porters soils; and Ashe loam, steep phase.

Use and management.—All of Ashe sandy loam, steep phase, has a forest cover, and part of it is in the Cherokee National Forest. Steep slopes, difficulty in controlling rapid runoff and erosion, low fertility, and inaccessibility make forest the best use on most farms.

Ashe sandy loam, eroded steep phase (Ao).—About 25 to 75 percent of the original surface layer of this light-colored soil has been removed by accelerated erosion. Small areas are scattered on 30- to 60-percent slopes throughout that part of the county underlain by granite. Internal and external drainage are rapid to very rapid. The soil is associated with Porters and other Ashe soils. It differs from the steep phase in being eroded, lower in organic matter, more droughty, and not so well supplied with plant nutrients; and in having a slightly heavier surface layer and greater susceptibility to further damage by erosion.

The present surface layer varies considerably in color and thickness. It is 5 to 10 inches thick and grayish yellow to light yellowish brown. The original thin dark surface layer of higher organic-matter content has largely been lost through erosion.

The soil is medium to strongly acid, low in organic matter and plant nutrients, and very permeable to air, roots and water throughout the profile. Although a few stones are on and in the soil and

there is an occasional bedrock outcrop, stoniness does not materially interfere with tillage.

Use and management.—The eroded steep phase of Ashe sandy loam is cleared and has been used for crops and pasture. An estimated 40 percent is now idle. A small part is used for the common field crops, and most of the rest for hay or pasture. Lime and fertilizers are not commonly used, and crop and pasture yields are low. Stoniness prohibits feasible use of farm machinery. If the soil is cultivated, erosion is difficult to control, and loss of soil material brings a decrease in fertility and productivity.

As the soil is difficult to work, difficult to conserve, and low in productivity for the common crops of the area, it is best suited to forest. Under some conditions, however, particularly on the milder slopes, it may be advisable to use it for pasture. Permanent pasture without amendments usually produces a low yield of poor quality, but moderate to heavy applications of lime and phosphate increase both yields and quality of pasture plants. Grazing should be closely controlled so as to maintain a good sod.

Ashe sandy loam, hilly phase (Ap).—The parent material of this soil of the hilly mountain areas is largely derived from granite, but small local areas are from gneiss. Milder relief (15- to 30-percent slopes) is its chief difference from the steep phase. External and internal drainage are rapid to very rapid. Areas are small and irregularly shaped and are associated chiefly with other Ashe soils and Porters, Tusquitee, Tate, and Perkinsville soils in the Ashe-Tusquitee-Perkinsville soil association.

Profile description:

0 to 10 inches, grayish-yellow friable sandy loam; in wooded areas the 2-inch surface layer is loose dark grayish-brown sandy loam.

10 to 30 inches, brownish-yellow to pale yellowish-brown friable heavy sandy loam.

30 inches +, highly mottled sandy loam and partly disintegrated rock material; bedrock at 2 to 5 feet.

Reaction is medium to strongly acid. The plant-nutrient content, water-holding capacity, and organic-matter content, except in the thin dark surface layer, are low. The soil is permeable to air, roots, and water. In most places a few rock fragments are on the surface and throughout the profile, and an occasional bedrock outcrop is common.

Boundaries between this and other mountain soils are indistinct; consequently, small areas of associated soils are included. Some included areas have a heavier subsoil than that described.

Use and management.—Although Ashe sandy loam, hilly phase, is now in forest, easily accessible areas might be cleared and used for pasture on some farms. Without amendments low yields of poor quality pasture may be expected, but under a high level of management that includes moderate to heavy applications of lime and phosphate and carefully controlled grazing, reasonably good pasture is obtained. To prevent serious loss of soil material through erosion, land newly cleared for pasture should be seeded to a mixture of pasture grasses and legumes as quickly as possible.

Ashe sandy loam, eroded hilly phase (An).—This sandy soil has developed on 15- to 30-percent slopes from residuum of light-colored

granite. It differs from the hilly phase chiefly in having lost much of the original surface soil through erosion; but in addition, its present surface soil is slightly heavier in texture and lower in plant nutrients and organic matter. Internal and external drainage are rapid to very rapid. The soil occupies small irregularly shaped areas widely distributed throughout the Ashe-Tusquitee-Perkinsville soil association; it is associated with Perkinsville, Tusquitee, Tate, and Porters soils.

A considerable part of the original surface layer has been eroded away; the present surface layer, 2 to 10 inches thick, is grayish yellow to light yellowish brown. A few small severely eroded spots are conspicuous owing to exposure of the subsoil.

The soil is medium to strongly acid and low in organic matter, plant nutrients, and water-holding capacity. It is very permeable to air, roots, and water. In most places a few rock fragments are on the surface and throughout the profile.

Use and management.—All of Ashe sandy loam, eroded hilly phase, is cleared and has been used for crops or pasture. About 10 percent is in corn, 5 percent in small grains, 25 percent in hay, 15 percent in rotation pasture, 25 percent in permanent pasture, and 20 percent in idle land.

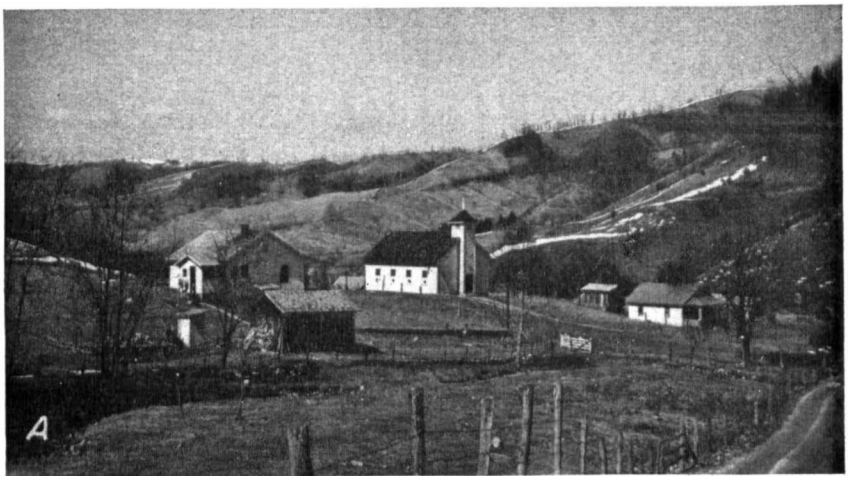
The soil is poorly suited to crops requiring tillage and is best used for semipermanent hay crops or pasture. Some areas, particularly those on the milder slopes, are suitable for tilled crops if they are grown in a long rotation with close-growing crops. An improved management program includes use of a long crop rotation consisting chiefly of close-growing crops, preferably legumes; increased liming; fertilization with high analysis fertilizer; increased use of cover crops; and carefully controlled grazing of permanent or rotation pastures. If strip cropping is practiced (pl. 1, *B*), the crop rotation can be shorter.

Ashe stony loam, steep phase (Av).—This soil has developed on 30- to 60-percent slopes from the residuum of granite and gneiss. It differs from Ashe loam, steep phase, chiefly in having more stones, shallower depth to bedrock, and more bedrock outcrops. It occurs in both large and small irregular-shaped areas in association with Porters, Perkinsville, Tusquitee, Masada, Congaree, Chewacla, Wehadkee, and other Ashe soils. Most areas are in the southeastern part of the county in the Ashe-Tusquitee-Perkinsville soil association. External and internal drainage are rapid.

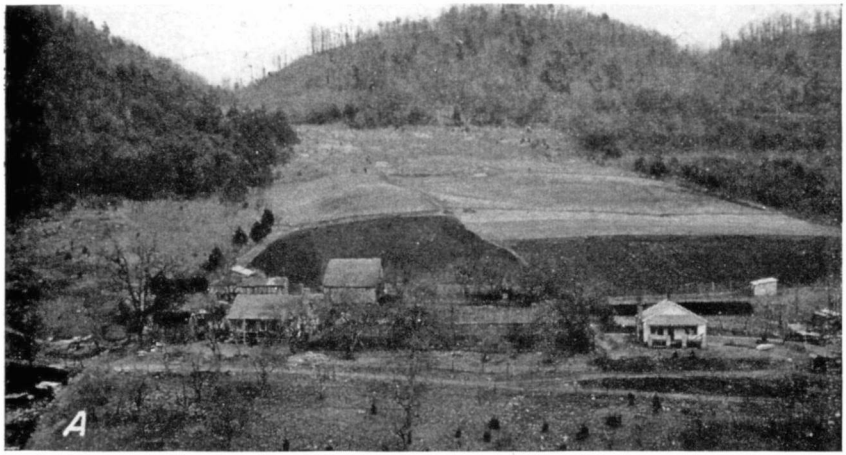
Profile description:

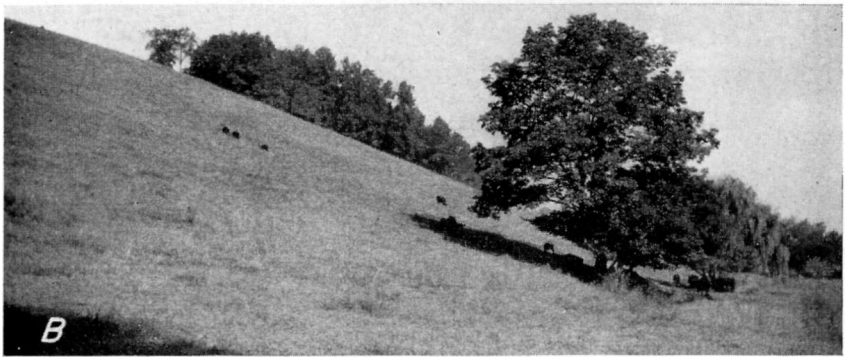
0 to 10 inches, grayish-yellow friable stony loam; in wooded areas, a 1- to 2-inch surface layer is stained dark with organic matter.
10 to 24 inches, pale yellowish-brown friable heavy stony loam.
24 inches +, highly mottled loam mixed with partly disintegrated rock fragments; bedrock at 1 to 5 feet.

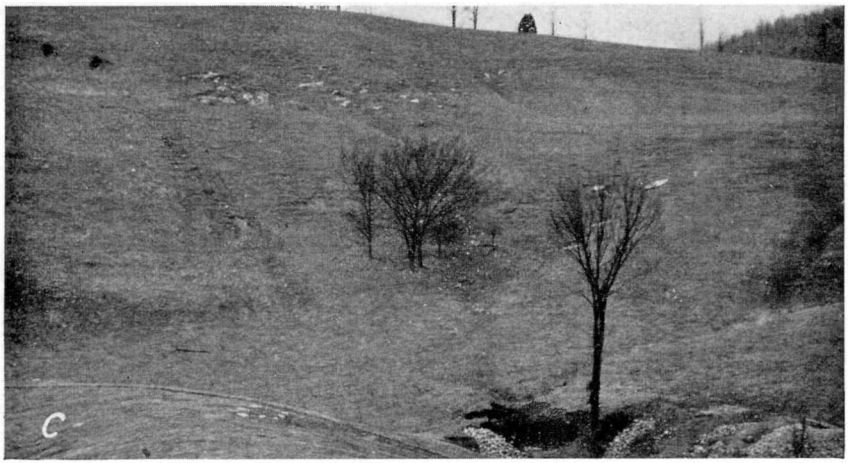
The entire profile is medium to strongly acid. The content of organic matter is low except in a thin surface layer occurring in wooded areas. The plant-nutrient content and water-holding capacity are low. Large and small fragments of stone on and in the soil interfere with cultivation. The porous friable soil permits easy penetration of plant roots and free movement of air and moisture.



A, Cleared land used for pasture on Ashe loam, eroded steep phase, in background; Tusquitee loam, rolling phase, in foreground.
B, Strip cropping on Ashe sandy loam, eroded hilly phase.
C, Tobacco on Camp silt loam, undulating phase.







A, Cleared area of Decatur silty clay loam, eroded rolling phase, in background is productive of most crops; wooded area is Stony rough land (Dunmore and Teas soil materials); area around farmhouse is Hiwassee clay loam, eroded rolling phase.

B, Permanent pasture of bluegrass, white clover, and lespedeza on Decatur silty clay loam, eroded steep phase, that has been treated with 3 tons of lime and 400 pounds of 43-percent phosphate fertilizer an acre.

C, Poor pasture on Dunmore silty clay loam, severely eroded steep phase, showing gullying.

As boundaries between this and other mountain soils are not distinct, small areas of Porters, Perkinsville, and other Ashe soils are included.

Use and management.—Practically all of Ashe stony loam, steep phase, is now in forest; a considerable part is within the Cherokee National Forest. Most of the privately owned forest has been cut over several times, and the present stand is small and includes many cull trees. Steepness, stoniness, low fertility, and low water-holding capacity make this soil unsuitable for crops and poor for pasture. It is probably best used for forest on most farms. For a discussion of forest management, see the section on Forests.

Ashe stony loam, eroded steep phase (AT).—This light-colored excessively drained soil has developed on 30- to 60-percent mountain slopes from the residuum of light-colored granite. It differs from the steep phase in being eroded, lower in organic matter, less well supplied with plant nutrients, and more droughty; and in having a slightly heavier surface layer and greater susceptibility to further damage by erosion. It is widely distributed throughout the Ashe-Tusquitee-Perkinsville soil association, where it is closely associated with Perkinsville, Tusquitee, Tate, Porters, and other Ashe soils.

A small acreage, chiefly along Simerly Creek and along Laurel Fork Creek in the vicinity of Bitter End School, is severely eroded. In this area practically all of the original surface soil has been eroded away and the subsoil is exposed.

Use and management.—All of Ashe stony loam, eroded steep phase, is cleared and has been used for crops and pasture. Now, most of it is either idle or in permanent pasture and a very small part is cropped. The area within the Cherokee National Forest is becoming reforested. Crop and pasture yields are commonly very low.

Steepness and stoniness prohibit use of heavy farm machinery. Erosion is difficult to control, and the loss of soil material has decreased fertility and productivity. Since the soil is difficult to work, difficult to conserve, and low in productivity for the common crops of the area, it is considered best suited to forest. Under some conditions, particularly on the milder slopes, it may be advisable to use it for pasture. Permanent pasture receiving no amendments usually produces low yields of poor quality. Applications of lime and phosphate should increase both yield and quality.

Ashe stony loam, very steep phase (AW).—Slopes of this phase are greater than 60 percent. Like Ashe stony loam, steep phase, this soil is light-colored, excessively drained, stony, and occurs in the mountains. It is somewhat more shallow over bedrock than the steep phase, however, and has steeper slopes and more bedrock outcrops. It occurs mainly in small areas on the very steep slopes around the heads of drains, principally in the Ashe-Tusquitee-Perkinsville soil association.

Some included areas are relatively free of stone, and a small acreage has a sandy loam surface soil.

Use and management.—Most of Ashe stony loam, very steep phase, is in forest. Crops or pasture are unsuitable because of steep slopes and stoniness. Forest is also poorly suited, but on most farms the soil is probably best used for that purpose.

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Ashe stony loam, hilly phase (Aʊ).—This stony soil of the hilly mountain areas has developed from the residuum of granite and gneiss. It differs from the steep phase in having a milder relief (15- to 30-percent slopes), being somewhat deeper, having a thicker and in many places heavier subsoil, and having a slightly darker surface soil. Like the steep phase it is under forest, where accelerated erosion has been slight. The native forest vegetation was chiefly deciduous, although it included many coniferous trees. The soil occurs in relatively small irregularly shaped areas and is widely distributed, chiefly in the Ashe-Tusquitee-Perkinsville soil association. External and internal drainage are rapid to very rapid.

Profile description:

0 to 10 inches, grayish-yellow friable stony loam.
10 to 30 inches, pale yellowish-brown friable heavy stony loam or stony clay loam.
30 inches +, highly mottled loam mixed with partly disintegrated rock fragments; bedrock at 1 to 5 feet.

The entire profile is medium to strongly acid. Water-holding capacity and plant-nutrient and organic-matter contents are low except in the thin surface layer in wooded areas. Stone fragments on and throughout the soil interfere with tillage. The soil is very permeable to air, roots, and water.

The boundaries between this and other mountain soils are indistinct; consequently, this soil includes small areas of associated soils. It also includes some areas that differ in having a reddish subsoil.

Use and management.—Although Ashe stony loam, hilly phase, is now in forest, accessible areas on some farms might be cleared and profitably used for pasture. The soil is considered suitable for pasture, but without amendments low yields of low quality may be expected. To prevent erosion of land newly cleared for pasture, seed a mixture of pasture grasses and legumes as quickly as possible. Lime, phosphate, and carefully controlled grazing are needed to establish and maintain a good stand of pasture plants.

Ashe stony loam, eroded hilly phase (As).—This light-colored stony soil has developed on 15- to 30-percent slopes from the residuum of granite and gneiss. It differs from the hilly phase chiefly in having lost much of its original surface soil; its present surface soil is therefore heavier, more variable in color, and lower in plant nutrients and organic matter. Internal and external drainage are rapid to very rapid. Widely distributed small areas occur throughout the Ashe-Tusquitee-Perkinsville soil association, where they are closely associated with other Ashe soils and with Porters, Perkinsville, Tusquitee, and Tate soils.

The soil is medium to strongly acid, very permeable, and low in water-holding capacity. Stone fragments are on the surface and throughout the soil in quantities sufficient to interfere with tillage operations.

As mapped, this soil includes small areas of associated upland soils. A small included acreage is severely eroded and differs from the soil described in having lost practically all the original surface soil. Some areas are also included that differ in having a reddish subsoil.

Use and management.—All of Ashe stony loam, eroded hilly phase, is cleared and has been used for crops and pasture. About 10 percent

is in corn, 5 percent in oats and other small grains, 25 percent in hay including lespedeza, 35 percent in pasture, and 25 percent in idle land or miscellaneous crops. Only a small acreage of alfalfa is grown; cabbage and green beans for market are grown to a limited extent. Recently there has been a marked trend toward greater acreages of legumes, grasses, and small grains; and with this, increased use of lime and phosphate.

Part of this soil, particularly that on milder slopes and less stony areas, is moderately well suited to crops grown in a long rotation. Close-growing crops—including small grains and deep-rooted legumes—should be used. Steeper areas are probably best suited to permanent pasture; some of the more severely eroded areas are probably best for forest. To obtain a satisfactory pasture, moderate to heavy applications of lime and phosphate are needed. Improved management would include more liberal use of lime and fertilizer, seeding of better pasture mixtures, and careful control of grazing.

Balfour loam, rolling phase (Bb).—This well-drained soil has developed from the residuum of granite and gneiss on the smoother mountain crests or plateaulike areas. Slopes range from 7 to 15 percent. The soil resembles the Porters in color, native vegetation, parent material, stoniness, and general associations but differs in being deeper and having a firmer finer textured subsoil. Its small irregularly shaped areas are associated chiefly with Porters and other Balfour soils. Areas are widely distributed in the extreme southern part of the county in the Porters-Tusquitee-Balfour and Perkinsville-Balfour-Matney soil associations.

Profile description:

0 to 8 inches, light-brown or brown very friable loam; in wooded areas the the upper part is stained dark with organic matter.
8 to 14 inches, light-brown friable loam.
14 to 40 inches, yellowish-brown friable clay loam having a weak fine to medium nutlike structure.
40 inches +, brownish-yellow to grayish-yellow, splotched with gray, clay loam; mixed in are partly disintegrated soft rock fragments; bedrock at 3 to 6 feet in most places.

The entire profile is medium to strongly acid. The supply of organic matter is relatively high, especially in the surface layers. Generally this soil is stone-free, but in a few localized areas stones may interfere with cultivation. Mica flakes are common throughout the profile. The soil is very permeable and easily penetrated by roots, air, and moisture. It retains moisture well and even during extended dry periods holds quantities sufficient for plant growth.

The cultivated soil differs from the uncultivated in having lost a considerable part of its original surface soil through accelerated erosion. The present surface soil is slightly heavier and somewhat lower in plant nutrients and organic matter on cultivated areas. Boundaries between Balfour soils and other soils of the mountains are not distinct. In consequence this soil includes small areas of associated soils, as the Perkinsville, Porters, and Ashe. Also included are soils intermediate in characteristics between this rolling phase and the Perkinsville, Porters, and Ashe. Some areas, especially those above 3,500 feet elevation, have dark-brown surface soil and subsoil.

Use and management.—About two-thirds of Balfour loam, rolling phase, has been cleared of forest and used for crops or pasture. Of

the cleared area, about 25 percent is in corn, 10 percent in small grains and miscellaneous crops, 35 percent in hay, and 20 percent in pasture. Some 10 percent of the cleared land is idle. The prevailing practice is to plow the land for all crops, the rotation consisting of corn, small grains or commercial vegetables, hay, and pasture. Under common management practices, corn produces 30 bushels; wheat, 14 bushels, and red clover, 1.1 tons of hay.

This phase is suited to crops common to the area. For most crops it is deficient in lime, nitrogen, phosphate, and other elements, but it responds to good management that supplies these elements. A good management program includes a suitable crop rotation, cover crops followed by row crops, use of more legume hay and pasture crops, increased use of lime and fertilizer (especially phosphate), contour tillage, and possibly mechanical means of water control.

Balfour loam, hilly phase (BA).—This brown friable soil has developed on 15- to 30-percent slopes from the residuum of granite and gneiss. It differs from the rolling phase in having a stronger slope and being more variable in depth to bedrock. On the steeper slopes it has a less distinct, firmer, finer textured subsoil layer and is in many characteristics intermediate between the rolling phase and Porters loam, eroded steep phase. Internal and external drainage are moderately rapid.

The small, irregularly shaped areas are associated with Porter, Ashe, and other Balfour soils. They are widely distributed in the southern part of the county but are confined largely to the Porters-Tusquitee-Balfour and Perkinsville-Balfour-Matney soil associations. The native forest consisted of mixed deciduous and coniferous trees.

The entire profile is medium to strongly acid, and the quantity of organic matter is relatively high, especially in the surface layers. The soil is relatively free of stone, but mica flakes are common throughout. The soil is very permeable to plant roots, air, and moisture and retains enough moisture for plant growth during extended dry periods.

Part of this soil may be dark brown, particularly around heads of drains and at elevations exceeding 3,500 feet. The cultivated soil differs from the uncultivated in having lost, in places, as much as 40 percent of the original surface soil through accelerated erosion. On eroded areas the present surface soil is slightly heavier textured and somewhat lower in plant nutrients and organic matter. Small areas of associated soils are included because boundaries are not distinct.

Use and management.—About two-thirds of Balfour loam, hilly phase, is cleared. Of this, 20 percent is in corn, 5 percent in small grains, 30 percent in hay, 25 percent in pasture, and 20 percent is idle. A small percentage is in potatoes and commercial vegetables. The more progressive farmers follow a rotation of corn, small grains or commercial vegetables, hay, and pasture, but crops on a large part of the soil are not systematically rotated. Corn produces about 22 bushels an acre; wheat, 11 bushels; and red clover, 0.9 ton of hay under common management practices.

Crops requiring tillage are suitable for this soil, but a high level of management is required to maintain productivity and prevent serious loss of soil material through erosion. The soil is moderately fertile and responds fairly well to good use and management. Most farm machinery can be used, but the heavier types only with difficulty. Use

of a long rotation consisting chiefly of close-growing crops, including deep-rooted legumes, and increased application of lime and fertilizer, especially phosphate, are desirable.

Buncombe loamy fine sand (Bc).—This excessively drained soil of the bottom lands occupies almost level flood plains along the Watauga, Doe, and Elk Rivers. The alluvium from which it is formed has washed from uplands underlain by granite and gneiss. The soil is similar to Congaree fine sandy loam in location, parent material, geographic distribution, and soil associates but differs in texture, color, stoniness, productivity, and use suitability. Areas are small and are in association with State, Masada, Chewacla, and Congaree soils.

This soil consists of loose brownish-yellow loamy fine sand throughout. The top 3 or 4 inches is stained somewhat darker in many places. Local areas may be gravelly or cobbly or both. The subsoil is typically stratified with coarse-textured material ranging from fine sand to fine gravel.

The soil is naturally medium or strongly acid, although much of it has been limed recently and is less acid. Organic-matter content and plant-nutrient content are low, and drainage is excessive. Owing to the coarse texture, the water-holding capacity is low. The entire soil contains a moderate quantity of small mica flakes. Some gravel and cobblestones are present but interfere with cultivation in only a few places.

Use and management.—Practically all of Buncombe loamy fine sand has been cleared and cultivated. Most of it is now in pasture or idle; only a small part is cropped. Susceptibility to flooding, droughtiness, and low fertility limit use suitability. Yields of corn, small grains, and most hay crops are very low; quick-maturing crops, as early potatoes and early garden vegetables, are probably best suited. On most farms, pasture is the best use, although the soil is relatively unproductive of most pasture plants. To obtain even fair yields of the better adapted crops, deficiencies in lime, nitrogen, and phosphate must be overcome.

Burton stony loam (Bd).—Among the upland soils, this one has the darkest color and highest content of organic matter. It has developed from residuum of granite and gneiss under stands of mountain oatgrass or alder-birch, known locally as grassy balds and alder balds. Areas are on mountaintops, high mountain slopes, and in some of the higher mountain gaps, all at elevations above 5,200 feet. Most slopes range from 7 to 30 percent, although some are greater.

Profile description:

0 to 14 inches, dark-gray (almost black) loose stony loam, very high in organic matter.
14 to 20 inches, yellowish-brown friable stony light clay loam.
20 to 36 inches, brownish-yellow friable stony clay loam splotched with gray; bedrock at 2 to 4 feet in most places.

Large and small fragments of stone on the surface and throughout the profile interfere with cultivation. Bedrock outcrops are common. This strongly acid soil is very permeable to plant roots and allows free movement of air and moisture. Rainfall is readily absorbed and retained.

Many characteristics are highly variable. The dark surface layer ranges from 8 to 18 inches thick. The soil, as mapped, includes poorly

to moderately well drained soils; the poorly and imperfectly drained are the most extensive. Included also are small areas of associated soils.

Use and management.—Most of Burton stony loam is still under its native vegetation. A large part is within Cherokee National Forest. Fertility is moderate, but use suitability is limited by the cool climate, relatively short frost-free period, and inaccessibility. The only adapted crops are the cool-season ones and those having a comparatively short growing period. Late cabbage, late potatoes, and buckwheat should do well. The soil is well suited to pasture. Many grasses grow well without amendments, but white clover and Kentucky bluegrass pasture are improved by applications of lime and phosphate.

Camp silt loam, undulating phase (Cc).—This well-drained soil of colluvial lands has formed at the base of slopes from which its parent material washed. The colluvium or local alluvium has washed from uplands underlain by purplish calcareous shale. The soil occupies 1- to 5-percent slopes in small irregularly shaped areas widely distributed throughout the Teas-Litz-Camp soil association. It is closely associated with Teas, Litz, Jefferson, Allen, Masada, Congaree, and other Camp soils.

Profile description:

0 to 10 inches, purplish-gray friable silt loam.
10 to 20 inches, light purplish-brown shaly silty clay loam.
20 to 48 inches, purplish-brown to reddish-brown friable silty clay loam.

This soil is medium acid and moderately well supplied with organic matter. It is relatively free of stones but throughout contains a variable quantity of tiny purple, green, and yellow shale fragments. It is permeable enough for easy penetration of plant roots and normal circulation of air and moisture. Water is readily absorbed and well retained.

Included are small areas of shaly colluvial-alluvial soils, dominantly yellowish throughout. These included areas are influenced by materials washed from Litz soils of the uplands.

Use and management.—Practically all of Camp silt loam, undulating phase, is cleared and used for general field crops. About 30 percent is in corn, 20 percent in small grains, 40 percent in hay and pasture, and 10 percent in other crops, including tobacco (pl. 1, *C*), potatoes, and vegetables. The more progressive farmers follow 3- to 4-year rotations of corn, small grains, and hay. Average acre yields under common management practices are: corn, 40 bushels; wheat, 14 bushels; tobacco, 1,550 pounds; and red clover, 1.4 tons of hay.

This soil is well suited to intensive use for crops, particularly intertilled crops, if adequately fertilized. The soil is moderatly deficient in lime, nitrogen, and phosphate for many crops. A short rotation that includes a deep-rooted legume is desirable. Control of runoff and erosion are minor problems, and special practices are not generally required.

Camp silt loam, rolling phase (Cb).—The parent material for this well-drained soil of the colluvial lands is local alluvium or colluvium washed from uplands underlain by purple calcareous shale. It differs from the undulating phase chiefly in occupying steeper slopes (5 to 15 percent). Furthermore, in many places, some soil material has eroded

away. In these the present surface soil is slightly heavier, the quantity of organic matter and plant nutrients is slightly less, and susceptibility to erosion is somewhat greater. The colluvial accumulation is thinner than that of the undulating phase, but it is 3 feet or more in most places. Areas are small, irregularly shaped, and widely distributed throughout the Teas-Litz-Camp soil association.

As mapped, this phase includes small areas of shaly colluvial soils, dominantly yellowish throughout, that have been influenced by material washed from Litz soils.

Use and management.—Practically all of the rolling phase of Camp silt loam has been cleared and used for crops and pasture. Of the land cleared, about 30 percent is in corn, 25 percent in small grains, 40 percent in hay and pasture, and 5 percent in miscellaneous crops. A 3- or 4-year rotation of corn, small grains, and hay is used by some farmers. Under common management practices, corn yields about 35 bushels an acre; wheat, 12 bushels; tobacco, 1,450 pounds; and red clover, 1.3 tons of hay.

Crops that require tillage are well suited if they are adequately fertilized. The stronger slopes increase susceptibility to damage by accelerated erosion, and measures for control of erosion or runoff should be practiced. These measures should include use of more grasses or other close-growing crops, such as small grains, and contour tillage where possible. Improved management practices also include increased use of lime and phosphate and growing a greater acreage of red clover and other legume crops.

Camp silt loam, hilly phase (CA).—The parent material for this well-drained colluvial soil washed largely from Teas soils underlain by purplish calcareous shale. It differs from the undulating phase chiefly in having steeper slopes (15 to 30 percent), but it also has a shallower colluvial deposit, more variable profile characteristics, a greater loss of soil material as a result of erosion, a slightly heavier surface layer, and a lower content of organic matter and plant nutrients. It is closely associated with Teas, Litz, Jefferson, Masada, and Congaree soils and is largely in the Teas-Litz-Camp soil association.

Included are small areas of colluvial soils, dominantly yellowish throughout. These included areas are influenced by material washed from Teas soils. Small areas of Teas and Litz soils are included on some of the steeper slopes.

Reaction is medium acid, and content of organic matter is moderate. Few to many tiny purple, green, and yellow shale fragments occur throughout the soil mass. A few local areas contain stones in numbers sufficient to interfere with tillage. The soil allows easy penetration of plant roots and normal circulation of air and moisture. Water is readily absorbed and well retained.

Use and management.—Most of Camp silt loam, hilly phase, has been cleared and cultivated. About 20 percent of the cleared land is in corn, 15 percent in small grains, 25 percent in hay, 25 percent in pasture, and 5 percent in miscellaneous crops. About 10 percent of the cleared land is idle. Under cultivation about 20 to 50 percent of the original surface soil has been lost through accelerated erosion. A 4-year rotation of corn, small grains, hay, and pasture is common. Under common management practices average acre yields are 25 bushels of corn, 10 bushels of wheat, and 0.7 ton of lespedeza hay.

The soil is moderately well suited to tilled crops, but stronger slopes and greater susceptibility to erosion make it less desirable than the rolling phase. A higher level of management is required to maintain productivity. Longer rotations that include more close-growing crops are needed, as well as an increased use of lime and phosphate. Contour tillage should be practiced wherever feasible; cover crops should follow all intertilled crops.

Camp stony silt loam, rolling phase (CD).—This purplish well-drained colluvial soil has formed from material washed largely from the Teas soils, which are underlain by purplish calcareous shale. It differs from Camp silt loam, rolling phase, in containing stones in numbers sufficient to interfere with cultivation. Relief ranges from nearly level to about 15 percent. The soil occupies small areas in the Teas-Litz-Camp soil association.

Reaction is medium acid. Supplies of organic matter and plant nutrients are moderately good. Few to many tiny purple, green, and yellow shale fragments occur throughout the soil mass. Shale bedrock fragments are on the surface and through the soil mass in quantity sufficient to interfere with tillage. Plant roots, air, and moisture permeate the soil easily, and water is readily absorbed and well retained.

Small areas of other Camp soils and some small areas of colluvial soils that are dominantly yellow throughout are included with this phase. The included areas are influenced to large extent by material washed from Litz soils.

Use and management.—Practically all of Camp stony silt loam, rolling phase, is cleared and used for general field crops. About 25 percent of it is in corn, 15 percent in small grains, 20 percent in hay, 20 percent in pasture, and 20 percent in miscellaneous crops or idle. Many farmers use a 4-year rotation of corn, small grains, hay and pasture, but systematic rotation of crops is not commonly practiced. The following average acre yields are expected under common management practices: Corn, 28 bushels; wheat, 10 bushels; and red clover, 1.2 tons of hay.

This soil is moderately well suited to crops but difficult to till because of its high content of stone. Fair yields are obtained without amendments, but to increase or to maintain productivity at a high level, increased use of lime and phosphate and a crop rotation that includes deep-rooted legumes are needed.

Chewacla fine sandy loam (CE).—This soil consists of general alluvium washed from uplands underlain by granite. In places, it has a slight admixture of material washed from uplands underlain by quartzite and shale. The parent materials are similar to those of the Congaree and Wehadkee soils, and any variations are due to differences in drainage. It is intermediate in drainage and many profile characteristics between the well-drained Congaree and the poorly drained Wehadkee. Surface runoff and internal drainage are slow. The soil is along most of the streams in or flowing from the Ashe-Tusquitee-Perkinsville and Porters-Tusquitee-Balfour soil associations. Relief is almost level, with a gradual slope in the direction of the flow of streams. The larger areas are along the Watauga River in the Congaree-State-Chewacla soil association.

Profile description:

0 to 14 inches, grayish-brown very friable fine sandy loam.
14 to 36 inches, brownish-yellow friable fine sandy loam to loamy fine sand splotched with gray.
36 inches +, gray gravelly loamy fine sand.

The soil is medium to strongly acid, moderately low in organic matter, and moderately well supplied with plant nutrients. It is characteristically somewhat gravelly, but not enough so to interfere with tillage. Some local areas may be free of gravel. The open porous character permits easy penetration of plant roots and free circulation of air, particularly in the surface and subsurface layers. The soil is subject to overflow during periods of high water. The subsoil at depths of 3 feet or more is saturated during most of winter and early spring.

Use and management.—Practically all of Chewacla fine sandy loam has been cleared and cultivated. Much is now in pasture, and a part is reverting to brush and undergrowth. About 15 percent is in corn, 5 percent in small grains, 20 percent in hay, 40 percent in pasture, and 20 percent in idle land. No definite rotations are followed; the land may be planted to corn in successive years or may be allowed to rest 1 to 4 years between tilled crops. Under common management corn yields about 35 bushels, and lespedeza 1.3 tons of hay.

This soil is suited to intensive use for crops; but productivity is moderately low, and choice of crops is limited by imperfect drainage and susceptibility to overflow. Corn and many forage crops are well suited, but red clover and small-grain crops are less well suited. Under continuous cropping fair yields are obtained without amendments, but if yields are to be increased or maintained at a high level, a short rotation that includes a legume and increased fertilization are required. Frequent but light applications of lime and increased use of phosphate, together with the growing of legumes in the rotations, are desirable management practices.

Chewacla gravelly fine sandy loam (CF).—This imperfectly drained soil is on first bottoms along streams flowing from uplands underlain by granite. It differs from Chewacla fine sandy loam in having gravelstones on the surface and through the soil mass in numbers sufficient to interfere materially with and in some places to prevent feasible cultivation. The areas are small and associated with Tusquitee, Congaree, Masada, Wehadkee, and other Chewacla soils.

Use and management.—Practically all of Chewacla gravelly fine sandy loam has been cleared and cultivated. Much of it is now in pasture and some is reverting to forest. Only a small part is cultivated, and crop yields are very low. Pasture, without amendments, is expected to give fair yields of fair quality.

Owing to high gravel content and imperfect drainage, this soil is poorly suited to crops and on most farms is best used for pasture. To establish and maintain even moderately high-yielding pasture of good quality, moderate to heavy applications of lime and phosphate are needed.

Clarksville cherty silt loam, eroded rolling phase (CH).—This phase has developed under a deciduous forest vegetation from the residuum of cherty dolomitic limestone. It occupies 7- to 15-percent

slopes, chiefly on ridge crests or milder ridge slopes. It is associated with Fullerton, Groseclose, Dunmore, and Greendale soils in the Great Valley. Most of it is in the Fullerton-stony land-Clarksville and Stony land-Fullerton-Clarksville soil association. Surface runoff is moderate, and internal drainage is moderately rapid.

Profile description:

0 to 8 inches, gray to grayish-yellow loose to very friable cherty silt loam.
8 to 30 inches, yellow to brownish-yellow moderately plastic cherty silty clay loam to silty clay having a moderately well developed medium nut structure.
30 to 60 inches +, yellow to brownish-yellow moderately plastic cherty silty clay streaked and splotched with gray; thin layer of decomposed yellow shale common; bedrock at 3 to 15 feet.

The entire profile is strongly acid, the content of organic matter is very low, and the content of plant nutrients is moderately low. Angular 1- to 6-inch chert fragments are on the surface and throughout the profile in sufficient quantities to interfere with tillage operations in most places. Small bedrock outcrops occur occasionally. The soil is permeable to plant roots, air, and moisture. Water is readily absorbed, but water-holding capacity is low.

Under cultivation, from 25 to 60 percent of the original surface soil has been lost through accelerated erosion. Organic-matter content is low under forest, and on cleared areas it has been almost completely lost through cropping and erosion. With progressive loss of the original surface soil there has been a loss of organic matter and plant nutrients, an increase in susceptibility to erosion, and a decrease in productivity for most crops.

As boundaries between this and the associated Fullerton and Groseclose soils are not always distinct, small areas of those soils are included. Small areas are also included that are similar to the Fullerton and Groseclose soils or are intermediate in profie characteristics.

Use and management.—Most of the eroded rolling phase of Clarksville cherty silt loam has been cleared and cultivated. About 25 percent of the cleared land is in corn, 5 percent in wheat, 5 percent in other small grains, 30 percent in hay, and 20 percent in pasture; about 15 percent is idle. Many of the better farmers use a 4-year rotation of corn, small grain, hay, and pasture, but crops are not systematically rotated on most farms. The following acre yields may be expected under common management practices: Corn, 25 bushels; wheat, 10 bushels; and lespedeza hay, 0.8 ton.

This soil is moderately well suited to most of the common field crops and to pasture. Its low fertility and water-holding capacity, however, result in low productivity for most crops. It is deficient in lime, nitrogen, phosphate, and possibly potash for most crops. Owing to the high content of chert, workability is only fair, but the soil can be worked over a wide range of moisture conditions without serious injury. Crops are frequently injured by lack of moisture. Winter crops or crops that mature in seasons of high rainfall produce relatively higher yields than those maturing late in summer and early in fall. The soil is only moderately susceptible to erosion, and if other management practices are at a high level, mechanical means of erosion control are not generally needed.

Clarksville cherty silt loam, hilly phase (Ck).—This light-colored soil has developed from the residuum of cherty dolomitic lime-

stone. The native vegetation consisted of deciduous forest. The soil differs from the eroded rolling phase in having stronger slopes of 15 to 30 percent and in not being eroded. It is widely distributed throughout the Great Valley, with most of its acreage in the Fullerton-stony land-Clarksville and Stony land-Fullerton-Clarksville soil associations. External and internal drainage are rapid.

The soil is strongly acid, and organic-matter content is low. Angular 1- to 6-inch chert fragments are on the surface and throughout the profile in quantities sufficient to interfere with tillage. There are occasional small bedrock outcrops. The soil is sufficiently permeable for easy penetration of plant roots and normal circulation of air and moisture. Water is readily absorbed, but water-holding capacity is low.

Boundaries between the Clarksville soils and the associated Fullerton and Groseclose soils are not distinct in places, and small areas of these associated soils are included. Many areas of included soils have characteristics intermediate between Clarksville, Fullerton, and Groseclose soils.

Use and management.—Clarksville cherty silt loam, hilly phase, is practically all in forest that has been cut over many times. The small stand includes many cull trees and grows slowly. The soil is poorly suited to crops but makes fair pasture under good management that includes applications of lime, nitrogen, phosphate, and possibly potash. It is low in fertility and water-holding capacity and, consequently, in productivity. It is moderately susceptible to erosion, but a pasture sod is adequate protection in most places.

Clarksville cherty silt loam, eroded hilly phase (CG).—This light-colored soil has developed on 15- to 30-percent slopes from the residuum of cherty dolomitic limestone. It differs from the hilly phase chiefly in being eroded. About 25 to 75 percent of the surface soil has been lost in most places, and in others, practically all of it has been lost. In addition, this phase has a slightly heavier surface layer, is more droughty, is more susceptible to further damage by erosion, and is not so well supplied with plant nutrients as the hilly phase. Areas are widely distributed throughout the Great Valley, mostly in the Fullerton-stony land-Clarksville and Stony land-Fullerton-Clarksville soil associations. Internal and external drainage are rapid.

The soil is strongly acid, low in organic matter and plant nutrients, and very permeable to air, roots, and water. Water is readily absorbed, but the water-holding capacity is low. Angular chert fragments, 1 to 6 inches in size, are on the surface and throughout the soil in quantities sufficient to interfere with cultivation.

Use and management.—All of Clarksville cherty silt loam, eroded hilly phase, has been cleared and used for crops or pasture. About 15 percent is now in corn, 20 percent in hay, 20 percent in pasture, 10 percent in miscellaneous crops, and 15 percent in small grains. The rest is idle. Crops generally are not systematically rotated. A few farmers use a 4-year rotation of corn, small grain, hay, and pasture. Under common practices, acre yields normally expected are 15 bushels of corn, 6 bushels of wheat, and 0.6 ton of lespedeza hay.

Low fertility, low water-holding capacity, and poor workability make the soil better suited to permanent pasture or semipermanent

hay crops than to crops requiring tillage. The soil is deficient in lime, nitrogen, and phosphate and responds readily to their addition, but the increased productivity resulting from their use is not so lasting as on some soils. Susceptibility to erosion is moderate, but a permanent pasture sod is adequate protection in most places.

Cobbly alluvium (Hamblen soil material) (CL).—This miscellaneous land type consists of very stony imperfectly drained alluvium washed largely from uplands underlain by sandstone, quartzite, slate, and shale. The alluvial deposit ranges from 3 to 15 or more feet deep. The soil is on first bottoms or low terraces along the smaller streams that head in mountains underlain by quartzite and sandstone. The slope is less than 2 percent. The small elongated areas are associated with Jefferson, Allen, Sequatchie, Staser, and Hamblen soils.

Profile description:

0 to 18 inches, grayish-brown loose very cobbly sandy loam.
18 to 30 inches, brownish-yellow very cobbly heavy loam.
30 inches +, yellow very cobbly sandy loam highly splotched and mottled with gray and brown.

The material is medium to strongly acid and relatively low in organic matter. In most places the surface layer is so cobbly as to make cultivation very difficult. Gravel and cobblestones constitute a large part of the soil mass throughout the depth of the accumulation. The porous friable nature of this material permits easy penetration of plant roots and free movement of air and moisture. Most of the soil is subject to overflow by the streams along which it occurs.

Use and management.—Cobbly alluvium (Hamblen soil material) has been cleared and cultivated. About 30 percent of it is in corn, 10 percent in wheat, 5 percent in other small grains, and 35 percent in pasture; 20 percent is land temporarily idle. Crops are not rotated systematically, although some farmers use 3- and 4-year rotations of corn, small grain, and lespedeza pasture.

The very high content of gravel and cobblestones limits suitability for crops requiring tillage or for semipermanent hay crops. Pasture is probably the best use on most farms, although yields are low. Fertility is moderately low, and lime and phosphate are needed to establish productive pasture. Under very intensive use, as for vegetable gardens, it may be feasible to improve workability by removing some of the cobblestones.

Congaree loam (CN).—This soil is derived from general alluvium washed from uplands underlain by granite and from slight admixtures of material washed from lands underlain by quartzite and shale. The alluvial deposit is 6 to 15 feet or more thick. Narrow elongated areas lie along most streams in the Ashe-Tusquitee-Perkinsville and Porters-Tusquitee-Balfour soil associations and along streams flowing from those areas. Chewacla, State, Masada, and other Congaree soils are closely associated. Surface runoff is slow, but internal drainage is moderate to rapid.

Profile description:

0 to 14 inches, light-brown to brown friable loam.
14 to 30 inches, brownish-yellow friable loam; stony in many places.
30 inches +, brownish-yellow heavy sandy loam.

The soil is medium to strongly acid and well supplied with organic matter and plant nutrients. The plow layer is virtually free of gravel and cobblestones. Its open friable character permits easy penetration of plant roots and free circulation of air. Rainfall is readily absorbed and well retained. In most places the soil is subject to periodic overflow from the streams along which it occurs. Much mica occurs throughout the profile.

As mapped, this soil includes small areas of State loam and Congaree fine sandy loam. It also includes some areas of dark soil in the vicinities of Siam and Hunter, which are similar to it agriculturally.

Use and management.—All of Congaree loam has been cleared and cultivated. About 30 percent is in corn; 15 percent in wheat; 10 percent in other small grains, including oats and barley; 30 percent in hay; 5 percent in vegetables and tobacco; and about 10 percent in other crops, including pasture. Generally crops are not systematically rotated, although some farmers follow a 3-year rotation of corn, small grains, and hay. The use of commercial fertilizer is limited, but if it is applied, corn, small grains, and soybeans receive moderately light applications. Under common practices, corn, yields 45 bushels an acre; wheat, 14 bushels; and lespedeza hay, 1.3 tons.

Of all the soils in the county, this one is probably best suited to intensive cropping. Moderate to high yields are expected under continuous cropping without the use of amendments. A very good response may be expected, however, from use of lime and phosphate and a short crop rotation that includes a legume. Under continuous cropping, profitable increases in yield are obtained by using nitrogen fertilizer. Periodic flooding somewhat limits use suitability, but it does replenish plant nutrients and organic matter.

Congaree fine sandy loam (Cm).—This soil of the first bottoms consists of general alluvium washed from uplands underlain by granite, and, in places, slight admixtures of materials washed from uplands underlain by quartzite and shale. It lies in narrow, elongated areas along streams in the Ashe-Tusquitee-Perkinsville and Porters-Tusquitee-Balfour soil associations or along streams flowing from those areas. Surface runoff is slow to moderate, and internal drainage is moderate to rapid.

Profile description:

0 to 12 inches, grayish-brown to brown loose fine sandy loam.
12 to 24 inches, brownish-yellow friable heavy fine sandy loam.
24 inches +, brownish-yellow loose loamy fine sand.

Much mica occurs throughout the soil. Only a few areas have a small quantity of gravel and small cobblestones scattered over the surface and through the profile, and then the number is not sufficient to interfere with tillage. In places the lower layers may contain considerable gravel or cobblestones. Rainfall is readily absorbed but is not retained so well as in Congaree loam. The soil is medium to strongly acid, contains a moderate quantity of organic matter and plant nutrients, and is easily permeated by plant roots and air. It is subject to overflow during periods of high water.

Included are small areas of Congaree loam, Buncombe loamy fine sand, and State loam.

Use and management.—All of Congaree fine sandy loam has been cleared and cultivated. Approximately 25 percent of it is in corn, 5 percent in oats, 10 percent in wheat, 5 percent in barley, 25 percent in hay, 15 percent in pasture, and 5 percent in tobacco, vegetables, and various other crops. About 10 percent of the land is idle. In general, crops are not systematically rotated, but a few farmers use a 3-year rotation of corn, small grain, and hay. The use of commercial fertilizer is limited, but when used, corn and small grains receive light applications. Under common management practices, corn yields 40 bushels an acre; wheat, 14 bushels; tobacco, 1,400 pounds; and red clover, 1.4 tons of hay.

The soil is well suited to intensive crop use. Susceptibility to overflow somewhat limits use suitability, but overflows bring material that serves to replenish the supply of organic matter and plant nutrients. This soil is less fertile and lower in water-holding capacity than Congaree loam; consequently, crop yields are less. Applications of lime and phosphate and use of a short rotation that includes a legume crop are necessary if yields are to be increased or maintained.

Dandridge shaly silt loam, steep phase (De).—This shallow upland soil is known locally as black slate land. It has developed on 30- to 60-percent slopes from the residuum of calcareous shale and occupies narrow steep ridge slopes in the extreme northwestern part of the county. It is confined to the Dandridge-Hamblen soil association and is associated chiefly with Hamblen, Leadvale, and other Dandridge soils. Surface runoff is very rapid.

Profile description:

0 to 6 inches, gray to yellowish-gray friable shaly silt loam having a moderately well developed crumb structure; in wooded areas the 2-inch surface layer is stained dark with organic matter.

6 to 20 inches, yellowish-gray to brownish-yellow moderately plastic shaly silty clay loam; partly disintegrated bedrock at 10 to 30 inches.

In most places the soil material contains numerous small shale fragments, many of which are calcareous, so that reaction is about neutral and the supply of lime is good. Bedrock outcrops are common in most areas. Organic-matter content is low except in the thin surface layer occurring in wooded areas. Phosphate and nitrogen are moderately low, but potash is fairly high. Owing largely to the shallow depth, water-holding capacity is low.

Texture, color, consistence, and depth to bedrock vary from place to place. Along the southeastern border of the county, near areas dominated by limestone, the subsoil in many places is reddish, heavier, and more plastic. This phase also includes some soils that are derived from residuum of interbedded limestone and shale and are more acid than the Dandridge soils.

Use and management.—Dandridge shaly silt loam, steep phase, is practically all in cut-over forest. The present stand is small and includes many cull trees. Shallowness, steep slope, and extreme susceptibility to erosion make this soil very poorly suited to crops. It is best suited to pasture, although some of the steeper slopes should remain in forest. Phosphorus is the only fertilizer needed for pasture; lime is not needed in most places. Carefully controlled grazing is necessary in order to maintain a good pasture sod.

Dandridge shaly silt loam, eroded steep phase (Dc).—This light-colored soil has developed from the residuum of calcareous shale on 30- to 60-percent slopes. Areas are distributed throughout the northwestern part of the county that is underlain by calcareous shale or black slate. The soil is associated chiefly with Hamblen, Leadvale, and other Dandridge soils. Surface runoff is very rapid.

This soil differs from the steep phase chiefly in being eroded. Over most areas, 25 to 75 percent of the original surface layer has been lost; and in some, all of the surface soil and a part of the subsoil have been lost. In addition, this phase is lower in organic matter and plant nutrients, has a slightly heavier surface layer, has a greater percentage of shale fragments in the surface layer, and is more susceptible to further injury from erosion than the steep phase. Well-defined surface soil and subsoil layers have not developed, and tillage and erosion have tended to obliterate the minor differences that existed.

Reaction is about neutral in most places. Water-holding capacity, organic-matter content, and plant-nutrient content, except potash, are low. Numerous small shale fragments occur throughout the profile, and some large fragments are scattered on more severely eroded areas. Bedrock outcrops are common in most places. The soil is moderately permeable to air, roots, and water.

Use and management.—Nearly all of the eroded steep phase of Dandridge shaly silt loam is cleared and used for pasture. A few areas are used for crops or are idle. Because of shallowness, steep slope, and extreme erodibility, the soil is very poorly suited to crops. It is fairly well suited to and productive of pasture plants, especially where phosphate has been applied. On severely eroded areas, yields are low unless a vegetative cover is established and maintained, deep subsoiling on the contour is practiced, phosphate is applied, and grazing is restricted. These practices should also benefit some of the less eroded areas where the present stand of pasture is thin. Phosphorus is likely the only fertilizer needed, as excellent pasture has been obtained where phosphate alone has been applied and management has been good in other respects. Lime is not needed in most places.

Dandridge shaly silt loam, very steep phase (Df).—Slopes exceeding 60 percent differentiate this soil from the steep phase. Like that phase, this is a light-colored excessively drained soil underlain by calcareous shale. It is shallower, however, has more bedrock outcrops, and its surface soil and subsoil layers are less distinct. The soil ranges from 5 to 20 inches deep. The soil material consists of grayish-yellow to brownish-yellow shaly silt loam to shaly silty clay loam. Areas are well distributed over the Dandridge-Hamblen soil association.

Use and management.—All but a few acres of Dandridge shaly silt loam, very steep phase, are still in forest. Steep slopes, rapid runoff, and shallow depth to bedrock make forest the best use. Areas cleared of forest are subject to severe erosion, and under present conditions, should be reforested.

Dandridge shaly silt loam, hilly phase (Dd).—This well to excessively drained shallow upland soil has developed on 15- to 30-percent slopes from the residuum of calcareous shale. It differs from the steep phase chiefly in having a milder relief. Its soil is somewhat

deeper, and surface soil and subsoil layers are more distinct. Areas are largely confined to the Dandridge-Hamblen soil association in the northwestern part of the county.

Profile description:

0 to 6 inches, gray to yellowish-gray friable shaly silt loam; in wooded areas a thin surface layer is stained dark with organic matter.

6 to 20 inches, yellowish-gray to brownish-yellow moderately plastic shaly silty clay loam; partly disintegrated bedrock at depths between 10 and 30 inches.

In most places the soil contains calcareous shale fragments and reaction is about neutral. Numerous small shale fragments are throughout the profile, and there is an occasional bedrock outcrop. Shale content and prevalence of bedrock outcrops vary greatly from place to place; some small areas are relatively free of shale.

Organic-matter content is low except for the thin dark surface layer. Nitrogen and phosphorus are moderately low, but the supply of potash is fairly high. Permeability is moderate, but owing to shallow depth and strong slope, surface runoff is rapid. Water-holding capacity is low.

Although the subsoil is predominantly brownish yellow, some included areas have a yellowish-red subsoil. Areas derived from the residuum of interbedded limestone and acid shale are included with this phase. Such areas are south of Elizabethton in the Stony land-Fullerton-Clarksville soil association. Other included soils, especially those from interbedded limestone and shale, are much more acid than this hilly phase.

Use and management.—Cut-over forest is on practically all of Dandridge shaly silt loam, hilly phase. The soil is poorly suited to crops, chiefly because it has strong slopes and is susceptible to great injury from erosion. Pasture is well suited, and yields are generally good unless there is an extended dry season. If the soil is cleared and used for crops or pasture, its management is similar to that for the eroded hilly phase.

Dandridge shaly silt loam, eroded hilly phase (DA).—This phase has developed chiefly from the residuum of calcareous shale but includes some areas derived from interbedded limestone and acid shale. It is a well to excessively drained light-colored shallow upland soil. It occurs in small, elongated, irregularly shaped areas in association with Leadvale, Hamblen, Fullerton, Dunmore, and other Dandridge soils. Areas are largely in the Dandridge-Hamblen soil association.

The soil differs from the hilly phase in being eroded—an estimated 25 to 75 percent of the original surface layer has been lost, and in some areas all the surface soil and part of the subsoil are gone. As erosion advances the surface comes nearer the topmost part of the bedrock shale, which is turned by the plow. On exposure the shale breaks down and becomes an integral part of the soil, making it difficult to determine the amount of soil material lost. Erosion causes little decline in productivity, except in places where recent accelerated erosion has been severe. Large shale fragments are on the surface of some severely eroded areas.

Use and management.—Practically all of Dandridge shaly silt loam, eroded hilly phase, has been cleared and used for crops or pasture. An estimated 35 percent is in cultivated crops, 35 percent is in pasture,

and 30 percent is idle. Of the cultivated land, about 20 percent is in corn, 60 percent in hay or pasture, 10 percent in wheat, and 10 percent in other small grains and miscellaneous crops.

Crops are not commonly rotated, nor are fertilizers ordinarily used. Some farmers apply about 150 pounds of superphosphate an acre for corn and small grains. Yields vary greatly, depending largely on the distribution and quantity of rainfall during the growing season.

This soil is well suited to pasture and poorly suited to field crops. Shallowness, which results in a low water-holding capacity, hilliness, and extremely high susceptibility to erosion are the chief limiting factors. By careful management, however, some farmers have used this soil for crops a number of years. Erosion is difficult to control, but increased yields have been reported where erosion has brought the calcareous shale bedrock within reach of the plow. Severe erosion is decidedly harmful, however, and should be prevented. Grasses and legumes, including alfalfa, are well suited, probably because the soil has a high supply of lime. Phosphate is usually required for high yields of grasses and legumes, but potash is not needed in many places. All cultivation should be on the contour. Subsoiling on the contour, which decreases surface runoff and increases water-holding capacity, is beneficial in many places.

Dandridge shaly silt loam, eroded rolling phase (DE).—More gentle slopes of 7 to 15 percent are the chief difference between this soil and the eroded hilly phase. Like other Dandridge soils, this one is about 10 to 30 inches deep over calcareous shale, moderately eroded, and well supplied with lime; it contains numerous calcareous shale outcrops and many shale fragments. The soil material is predominantly grayish-yellow to brownish-yellow moderately friable shaly silt loam to silty clay loam. Associations, distribution, and variations are similar to those of other Dandridge soils. The narrow elongated areas occupy ridge crests.

Use and management.—All of Dandridge shaly silt loam, eroded rolling phase, is cleared and used for crops or pasture. About 20 percent is in corn, 10 percent in wheat, 10 percent in other small grains, 50 percent in hay or pasture, and 10 percent in miscellaneous crops or idle. Average acre yields under prevailing management practices are 13 bushels of corn, 5 bushels of wheat, and 0.7 ton of red clover hay.

The management requirements are similar to those for the eroded hilly phase, but the gentler slopes of this soil make it somewhat easier to work, better suited to crops, and easier to protect from erosion. Because of shallowness, the soil cannot be said to be well suited to crops; however, it supports good pasture, especially where phosphate has been applied.

Decatur silty clay loam, eroded rolling phase (DH).—This soil of the limestone valleys has developed largely from the residuum of high-grade limestone but includes some soil derived from high-grade dolomitic limestone. Areas are largely confined to the Decatur-Dunmore-stony land soil association, in close association with the Dunmore, Jefferson, Allen, Teas, Litz, Camp, and Emory soils and with the stony miscellaneous land types. Slopes range from 7 to 15 percent. Surface runoff is moderately rapid, and internal drainage is moderate.

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Profile description:

0 to 8 inches, dark-brown friable silty clay loam with a moderately well developed medium crumb structure.
8 to 16 inches, brown to reddish-brown friable silty clay loam having a weakly developed fine to medium nut structure.
16 to 60 inches, reddish-brown to dark-red moderately plastic silty clay with a well developed medium to coarse nut structure.
60 inches +, reddish-brown to yellowish-brown moderately plastic silty clay splotched with gray in many places; structure less distinct than that of above layer; bedrock at 7 to 20 feet in most places.

The entire profile is medium to strongly acid, the quantity of organic matter is moderate, the content of plant nutrients is high, and water-holding capacity is relatively high. Although this soil is almost free of stone, there are a few small rock outcrops and narrow ledges of limestone. This soil is sufficiently friable for easy penetration of plant roots and adequate movement of air and moisture. Moisture is readily absorbed and well retained.

As a considerable part of the original surface soil has been lost through erosion, the present surface layer is highly variable in thickness (0 to 10 inches) and color (brown to reddish brown). In many small severely eroded spots all of the surface soil is missing and the red subsoil is exposed.

Boundaries between the Decatur and the associated Dunmore soils are not always distinct, and small areas of the associated soils are included with this phase. Some included soils are lighter colored than the soil described both in surface soil and subsoil. Others vary greatly in degree of erosion; most are moderately eroded but some are uneroded and others are severely eroded. A few areas have 2- to 7-percent slopes.

Use and management.—Most of Decatur silty clay loam, eroded rolling phase, has been cleared of forest and used for crops and pasture. An estimated 25 percent of the cleared land is in corn; 20 percent in small grains; 20 percent in hay, mostly lespedeza; 20 percent in pasture; 10 percent in other crops; and 5 percent is idle. Although a wide variety of crops is grown, systematic rotations are not practiced. Some of the better farmers use a 4-year rotation of corn, small grain, hay, and pasture.

Under prevailing management practices, the following acre yields are obtained: Corn, 40 bushels; wheat, 21 bushels; and red clover, 1.5 tons of hay.

This soil is well suited to the common crops of the county. The loss of soil material through erosion has resulted in loss of organic matter and plant nutrients, lowering of the water-holding capacity, and increased difficulty in maintaining good tilth. Still it is one of the better soils of the county for crop production (pl. 2, *A*), and excellent response can be expected from adequate fertilization, proper rotations, and other improved management practices. Rotations can usually be moderately short. Supplies of lime, phosphate, and nitrogen in the soil are not enough for high yields of most crops, and potash is not sufficient for some crops. The soil is moderately susceptible to erosion; but if all tillage is done on the contour, cover crops follow all intertilled crops, and rotations include close-growing crops, mechanical means of erosion control, as terraces, are not likely to be needed.

Decatur silty clay loam, eroded hilly phase (DG).—The eroded hilly phase differs from the eroded rolling phase chiefly in having a steeper slope (15 to 30 percent), but it is also generally more eroded. In most places some subsoil has been mixed with remnants of the original surface soil, and the present surface layer is therefore a reddish-brown moderately friable silty clay loam. The subsoil, similar to that of the other Decatur soils, is dark-red moderately plastic silty clay. Areas are largely confined to the Decatur-Dunmore-stony land soil association. Dunmore, Teas, Litz, Emory, Lindside, Jefferson, and Allen soils and stony miscellaneous land types are closely associated.

Use and management.—All of the eroded hilly phase of Decatur silty clay loam has been cleared and used for crops and pasture; only a small part is idle. Yields are normally lower than on the eroded rolling phase. Although a variety of crops are grown, they are not systematically rotated, nor is fertilization commonly practiced.

Owing to stronger slope, this soil is not so well suited to crops as the eroded rolling phase and management is considerably more exacting. It requires longer rotations and less frequent growth of row crops. In many areas row crops should be avoided. Contour tillage is desirable but may be impractical in certain fields. The soil should not be left bare for extended periods, and a cover crop should follow all intertilled crops. Contour strip cropping is beneficial where slopes are suitable. Growing grasses and legumes and turning under green manures, especially leguminous green manures, should increase the organic-matter content and nitrogen and improve tilth. For similar crops the fertilizer requirements presumably would be similar to those for the other Decatur soils.

Decatur silty clay loam, severely eroded hilly phase (DL).—Most of the original surface soil and, in places, a part of the subsoil have been eroded from this phase. The present surface layer—a reddish-brown moderately friably silty clay loam or silty clay—consists largely of subsoil material, but remnants of the original surface soil remain in a few places. The subsoil is dark-red moderately plastic silty clay. This phase differs from the eroded hilly phase chiefly in being more eroded, but it is also lower in organic matter, plant nutrients, and water-holding capacity. Small areas are widely distributed throughout the Decatur-Dunmore-stony land soil association on 15- to 30-percent slopes.

Use and management.—Decatur silty clay loam, severely eroded hilly phase, has been cleared of its forest cover for a number of years. It has been used for crops and pasture, but a large part is now lying idle. Crop and pasture yields are low under prevailing management.

Chiefly because this soil has been injured more by erosion, it is less suitable for agriculture than the eroded hilly phase. Good tilth is difficult to maintain. If cultivated when wet, the soil puddles readily; and on drying after heavy rains it tends to form a hard crust that hinders the emergence of young plants. Because the soil absorbs water slowly, runoff is relatively great. Plants are easily injured by drought. Tillage is impeded by both the hilly slopes and the heavy plow layer.

In its present condition this soil is poorly suited to tilled crops and better suited to permanent pasture or semipermanent hay. Lime and phosphate are essential for establishing and maintaining good pasture. The growing of grasses and legumes—especially alfalfa, sweetclover, and other deep-rooted legumes—over a period of years should somewhat overcome the decreased productivity resulting from severe erosion.

Decatur silty clay loam, eroded steep phase (Dk).—Slopes of this phase range from 30 to 60 percent. Like the eroded hilly phase, this phase has developed from the residuum of high-grade limestone and has lost a considerable part of the surface soil through erosion. The present surface layer is brown to reddish-brown moderately friable silty clay loam. The subsoil, like that of other Decatur soils, is reddish-brown to dark-red moderately plastic silty clay. Depth to bedrock—less than for the less steep Decatur soils—ranges from about 3 to 12 feet or more. Areas are largely confined to the Decatur-Dunmore-stony land soil association.

Use and management.—About 15 percent of Decatur silty clay loam, eroded steep phase is in cut-over forest, 20 to 30 percent is idle, and the rest is largely in hay or pasture. Ordinarily this soil is considered too steep and too susceptible to erosion for any extended production of field crops. It is better suited to permanent pasture. Excellent pasture can be obtained and maintained if lime and phosphate are applied (pl. 2, *B*) and grazing is carefully controlled.

Decatur silty clay loam, severely eroded steep phase (Dm).—In degree of erosion this soil is similar to the severely eroded hilly phase, but it differs in having steeper slopes of 30 to 60 percent. All or nearly all of the original surface soil has been lost, and the moderately plastic dark-red subsoil is exposed in many places. A few shallow gullies have formed in many areas. This soil is similar to the other Decatur soils in association and distribution, being confined largely to the Decatur-Dunmore-stony land soil association.

Use and management.—Crops are grown on only a small part of Decatur silty clay loam, severely eroded steep phase. Some is used for pasture, but much is idle and covered with brush and weeds. This soil is severely injured by erosion, which, together with the steep slopes, makes it extremely poorly suited to crops and poorly suited to pasture. On most farms it is best used for forest in its present condition. Pasture can be obtained at considerable expense and risk of failure. Lime and phosphate are required, and some of the gullies may have to be leveled. Good pasture, once established, does well if properly managed.

Dunmore silty clay loam, eroded rolling phase (Dr).—This well-drained soil has developed on 7- to 15-percent slopes from slightly clayey to moderately high-grade limestone or dolomitic limestone. The native vegetation was deciduous forest. This soil is widely distributed throughout the Great Valley, but the major acreage is in the Dunmore-Fullerton-stony land soil association. Fullerton, Emory, Lindside, and Decatur soils and the stony land types are closely associated.

Profile description:

0 to 8 inches, grayish-brown to light yellowish-brown friable or moderately friable silty clay loam with a weak medium crumb structure; in wooded areas a thin surface layer, about 2 inches thick, is stained dark with organic matter.

8 to 12 inches, yellowish-brown moderately friable silty clay loam with a weak medium nut structure.

12 to 36 inches, yellowish-brown to yellowish-red moderately to strongly plastic silty clay having a well-developed medium nut structure.

36 inches +, brownish-yellow plastic silty clay splotched with gray and brown; small shale fragments in places; bedrock at 3 to 10 or more feet.

This soil is medium to strongly acid and relatively high in water-holding capacity, plant nutrients, and, except in the more severely eroded areas, organic matter. It is practically free of stone, although bedrock outcrops occur in a few places. Owing to the dense subsoil, moisture absorption is slow. Surface runoff is moderately rapid.

Much of the original surface layer has been removed by erosion, and the present surface layer varies greatly in color (grayish brown to yellowish red) and thickness (4 to 8 inches). In a few severely eroded spots all the original surface layer is gone and the reddish subsoil is exposed.

Most areas are moderately eroded, but a few are uneroded and others severely eroded. Some included soils have formed from clayey limestone; they are shallower, heavier, and less permeable than the soil described. Small areas of associated soils are also mapped with this soil.

Use and management.—Most of Dunmore silty clay loam, eroded rolling phase, has been cleared and used for crops or pasture. About 30 percent of the land is in corn, 10 percent in small grains, 35 percent in hay (including lespedeza and alfalfa), and 15 percent in pasture. Approximately 10 percent is idle, in miscellaneous crops, or in forest. Usually the land is turned for all crops except grass. Systematic crop rotations are not common, but some of the more progressive farmers use a 4-year rotation of corn, small grains, and hay and pasture. The following acre yields are normally expected under common management practices: Corn, 35 bushels; wheat, 13 bushels; and red clover, 1.4 tons of hay.

Most of the common field crops and pasture (pl. 3) are well suited. Slow permeability of the subsoil handicaps production of row crops, as it inhibits absorption and percolation of water, and thereby tends to make the surface soil alternately extremely wet and dry. Restricted absorption of water naturally increases surface runoff and is one of the more important factors accounting for erodibility. The greater susceptibility to erosion and less favorable moisture conditions of this soil are the chief causes of differences in use suitability, management requirements, and productivity between it and Decatur silty clay loam, eroded rolling phase. Rotations should be longer than for that soil and they should include close-growing crops, especially grasses and legumes, more of the time. Where feasible, deep-rooted crops, such as alfalfa and sweetclover, should be grown periodically to improve the permeability of the subsoil.

Tillage should be on the contour where possible. Engineering measures may help control runoff and erosion, but considering the

unfavorable consistence of the subsoil, terraces would be of doubtful value. The soil is deficient in lime, phosphate, and nitrogen for most crops and may be slightly deficient in potash in places.

Dunmore silty clay loam, eroded hilly phase (Dp).—This soil differs from Dunmore silt loam, hilly phase, chiefly in being eroded. A considerable part of the original surface soil has been lost, and in a few severely eroded spots, the subsoil is exposed. Areas are widely distributed throughout the western part of the county, but the largest acreages are in the vicinity of Central School, Milligan College, and south of Elizabethton. The soil occupies relatively short ridge slopes that range from 15 to 30 percent in gradient.

The present surface layer, which consists of a mixture of the subsoil and the remnants of the original surface soil, is heavier in texture and lower in organic matter and plant nutrients than the original. It ranges from grayish brown to yellowish red and is 2 to 10 inches thick. Like that of the other Dunmore soils, the subsoil is moderately to strongly plastic yellowish-brown to yellow-red silty clay.

Use and management.—Practically all of Dunmore silty clay loam, eroded hilly phase, has been cleared for many years. An estimated 20 percent is in corn, 10 percent in small grains, 30 percent in hay crops, 20 percent in pasture, and 20 percent in miscellaneous crops or idle. A variety of crops are grown but not systematically rotated on many farms. Some fertilization is practiced, but applications are light except on tobacco. Under the prevailing management practices, 23 bushels of corn, 11 bushels of wheat, and 1.3 tons of red clover hay an acre are average yields.

The soil is moderately well suited to crops grown under a high level of management. It is moderately fertile, although somewhat deficient in lime, nitrogen, and phosphate for many crops. The supply of organic matter is low, and good tilth is difficult to maintain. The range of moisture conditions over which the soil can be tilled without injury is narrow. Moisture absorption is relatively slow, runoff is rapid, and a limited quantity of moisture is retained for growing plants. Owing to rapid runoff, susceptibility to erosion is great.

Crop rotations should be long and consist of close-growing crops, preferably grasses and legumes. All tillage should be on the contour if at all feasible, and strip cropping is desirable on the longer slopes. On many farms, this soil is probably best used for pasture or semipermanent hay. Indications are that good pasture can be established and maintained with relative ease if adequate quantities of lime and phosphate are used.

Dunmore silty clay loam, severely eroded hilly phase (Dt).—This soil has 15- to 30-percent slopes. Most of the original surface layer has been lost, and the present surface layer consists largely of yellowish-brown to yellowish-red subsoil material. Gullies 1 to 3 feet deep are common. In places, intergully areas may still retain a considerable part of the original surface soil. This phase is widely distributed throughout the Great Valley part of the county, the acreage being in the Dunmore-Fullerton-stony land soil association.

Use and management.—All of Dunmore silty clay loam, severely eroded hilly phase, has been cleared and used for crops and pasture, but most of it is now lying idle. Some areas are used for pasture, and

a small acreage for crops. Crop yields are generally very low, and failure to obtain hay stands is common.

This soil has been severely injured by erosion and is better suited to pasture or semipermanent hay than to crops requiring tillage. Lime and phosphate are essential to establish and maintain good pasture. When it is necessary to grow crops, hay crops should be selected. Good stands of alfalfa have been obtained where lime, phosphate, and manure has been applied, but unfavorable tilth sometimes makes it difficult to obtain satisfactory stands. If grasses and deep-rooted legumes were grown for a number of years, productivity might be increased, and possibly the soil could then be used in a long crop rotation.

Dunmore silty clay loam, eroded steep phase (Ds).—This steep well-drained soil has formed from the residuum of slightly clayey to high-grade limestone or dolomitic limestone. It differs from Dunmore silt loam, steep phase, chiefly in having lost a considerable part of its original surface soil. Also, its present surface soil is somewhat heavier and more variable in color (grayish brown to yellowish red) and thickness (2 to 10 inches), and lower in organic matter and plant nutrients. This phase is closely associated with Decatur, Fullerton, Emory, Lindside, and other Dunmore soils and is widely distributed throughout the Great Valley part of the county.

Use and management.—Dunmore silty clay loam, eroded steep phase, has been cleared and used for crops and pasture. Most of it is used for pasture or hay, but some is in other crops and some is idle.

Steep slopes, loss of organic matter and plant nutrients through cropping and erosion, and extreme susceptibility to erosion make this soil unsuitable for crops and only moderately well suited to pasture. Good pasture can be established and maintained only under carefully controlled grazing and a high level of management that includes use of lime and phosphate.

Dunmore silty clay loam, severely eroded steep phase (Du).—This soil differs from Dunmore silty clay loam, eroded steep phase, in being more eroded and from Dunmore silty clay loam, severely eroded hilly phase, in having a steeper slope—usually 30 to 60 percent. All or nearly all of the original surface soil has been lost, and the yellowish-brown to yellowish-red subsoil is exposed in many places. A few gullies 1 to 3 feet deep have formed.

Use and management.—Although all of this severely eroded steep phase has been cleared and used for crops and pasture, only a small part is now so used. Much land is lying idle under a cover of brush and weeds. Its severe erosion and steep slope make it extremely poorly suited to crops, poorly suited to pasture, and best suited to forest.

Pasture can be obtained at considerable expense and risk of failure (pl. 2, *C*). Lime and phosphate are required, and barnyard manure is helpful on galled spots. Nitrogen may be necessary at first, but legumes seeded in the pasture mixture should supply necessary nitrogen after the pasture is well established. Once good pasture is established, it does well if properly managed.

Dunmore silt loam, hilly phase (Dn).—Residuum of slightly clayey to high-grade limestone or dolomitic limestone is the material from which this soil is derived. The vegetation is deciduous forest.

Areas are widely distributed throughout the Great Valley part of the county, the greater acreage being in the Dunmore-Fullerton-stony land soil association and closely associated with Fullerton, Decatur, Emory, Lindside, and Groseclose soils. Slopes range from 15 to 30 percent.

Profile description:

0 to 8 inches, grayish-brown friable silt loam; a thin surface layer is stained dark with organic matter.
8 to 12 inches, yellowish-brown moderately friable silty clay loam.
12 to 34 inches, yellowish-brown to yellowish-red moderately to strongly plastic silty clay having a well-developed medium nut structure.
34 inches +, brownish-yellow plastic silty clay containing small shale fragments in places; bedrock at 3 to 10 or more feet.

The soil is medium to strongly acid and relatively high in organic-matter content, especially in the surface layer. Plant-nutrient content is moderately high. The soil is almost stone-free, but small outcrops of bedrock occur in places. Moisture is absorbed somewhat slowly because the subsoil is dense. Permeability is sufficient for normal root distribution and adequate circulation of air and moisture.

As mapped this soil includes small areas of geographically associated soils, as well as some soils shallower, heavier, and less permeable that are derived from clayey limestone residuum.

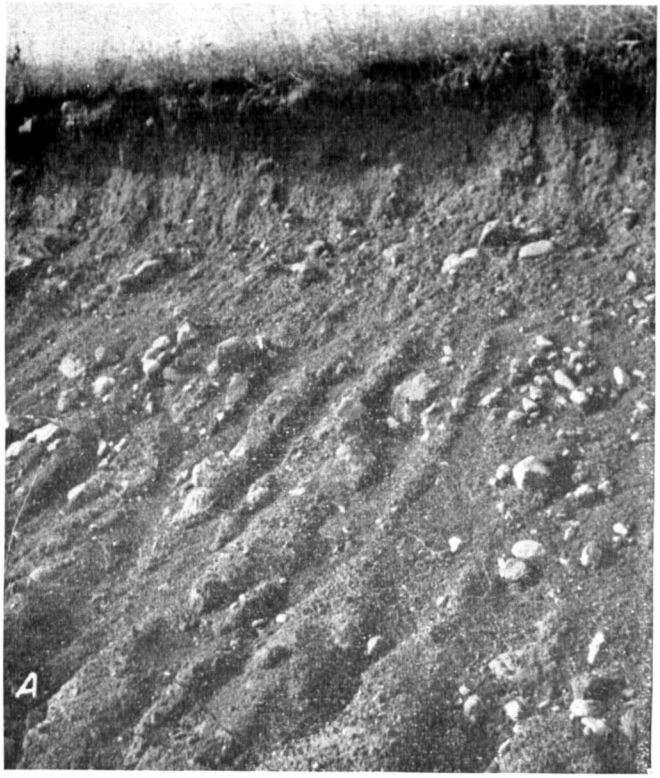
Use and management.—All of this hilly phase is now in forest. Although it is fairly well suited to crops and well suited to pasture, many areas could not be cleared feasibly because they are poorly located in relation to other tillable land. If cleared, their use and management would be similar to that for Dunmore silty clay loam, eroded hilly phase.

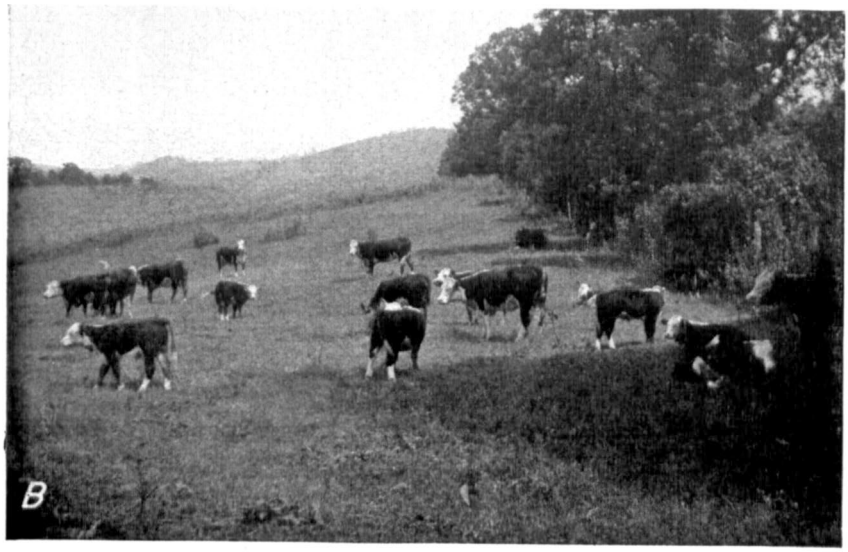
Dunmore silt loam, steep phase (Do).—This well-drained soil has formed largely from the residuum of slightly clayey to high-grade limestone or dolomitic limestone. It differs from Dunmore silty clay loam, eroded steep phase, chiefly in having steeper slopes (30 to 60 percent). In addition, it has less depth to bedrock, more bedrock outcrops, and less distinct surface soil and subsoil layers. To a depth of about 8 inches the surface soil is grayish-brown friable silt loam. The subsoil is yellowish-brown to yellowish-red moderately to strongly plastic silty clay.

This relatively inextensive soil is widely distributed over most of the Great Valley part of the county. Decatur, Fullerton, and Emory soils and the stony land types are closely associated. As mapped, this phase includes small areas of associated soils and areas derived from clayey limestone. The areas from clayey limestone are heavier, more plastic in the subsoil, and shallower over bedrock.

Use and management.—Although Dunmore silt loam, steep phase, is now in forest, it is moderately well suited to permanent pasture. On many farms, however, areas are relatively inaccessible for use as pasture. Ordinarily, the soil is too steep and too susceptible to erosion for extended production of field crops. Good to excellent pasture can be obtained, especially with the use of lime and phosphate. A sod-forming pasture mixture should be seeded soon after clearing to prevent any serious soil loss from erosion, and grazing should be carefully controlled.

Strip cropping of common field crops on Dunmore silty clay loam, eroded rolling phase.





A, Hiwassee clay loam, eroded undulating phase, is characteristically cobbly throughout, especially at depths below 2 or 3 feet.
B, Grazing on bluegrass, white clover, and lespedeza pasture on Jefferson stony fine sandy loam, eroded rolling phase.

Emory silt loam, undulating phase (Eb).—This soil of the colluvial lands has formed from materials accumulated at the bases of slopes occupied by Dunmore, Decatur, and associated soils. It occupies relatively narrow and elongated areas that are fairly well distributed throughout the area underlain by high-grade limestone. Most of it is in the vicinity of Winner in the Decatur-Dunmore-stony land soil association and is associated with Decatur, Dunmore, Lindside, and Hayter soils. Internal and external drainage are moderate. Relief ranges from nearly level to slopes of about 7 percent.

Profile description:

0 to 20 inches, brown to light-brown friable silt loam.
20 to 40 inches, reddish-brown to yellowish-brown moderately friable silt loam to silty clay loam having a few yellow splotches in the lower part.
40 to 60 inches, yellowish-brown moderately plastic silty clay loam to silty clay; depth of accumulation ranges from 3 to 10 or more feet.

This soil is medium acid, well supplied with organic matter and plant nutrients, easily permeable to plant roots, air, and moisture, and relatively free of stone. Water is readily absorbed, and the water-holding capacity is high.

Characteristics vary from place to place, depending largely on the kind of soil from which the parent material has washed. The color in most places is similar to that of the soil from which the material has washed.

A few included areas have formed from accumulations in shallow well-drained sinks or on narrow bottomlike areas along intermittent drainageways rather than on gently sloping foot slopes.

Use and management.—All of Emory silt loam, undulating phase, has been cleared and cultivated, most of it being used for field crops. An estimated 30 percent is in corn, 25 percent in small grains, 30 percent in hay and pasture, and 15 percent in miscellaneous crops or idle. Tilth is good and easy to maintain. Fertilizer is commonly used only on tobacco and vegetable crops. The wide variety of crops grown is not systematically rotated on many farms. Average acre yields under prevailing management are about 55 bushels of corn, 1,800 pounds of tobacco, and 1.6 tons of red clover hay.

This soil is well suited to intensive use for all the common crops of the county. Productivity, workability, and conservability are all favorable, and management requirements are simple. Ordinarily, good yields of many crops can be obtained without rotation or fertilization, but increased yields can be expected from both practices. Short rotations, such as corn-legume-hay rotation, are well suited. Lime and phosphate content is somewhat deficient for maximum yields of many crops. Needs for nitrogen and potash depend largely on the cropping system followed. In general, protection against either erosion or flooding is not required. Precautions may be necessary in some places to prevent excessive deposition of material washed from the slope above. A light deposition—if it does not consist of silty clay subsoil material—is ordinarily beneficial to the soil.

Emory silt loam, rolling phase (Ea).—Steeper slopes (7 to 15 percent), less depth of accumulation, thinner soil layers, slightly lower quantity of organic matter, a slightly heavier surface layer, greater susceptibility to accelerated erosion, and a smaller supply of plant

nutrients distinguish this phase from the undulating phase. It is a brown well-drained colluvial soil that has formed from material accumulated at the bases of slopes occupied by Dunmore, Decatur, and associated soils. Areas are relatively small and widely distributed throughout the part of the county underlain by limestone. Most of the acreage is in the Decatur-Dunmore-stony land soil association. Dunmore, Decatur, Lindside, and other Emory soils are close associates of this soil.

Use and management.—This rolling phase is cleared and used for general field crops. Many areas are so small they do not receive individual attention but are tilled with associated soils. About 25 percent of the land is in corn, 25 percent in small grains, 30 percent in hay, and 20 percent in miscellaneous crops or idle. The prevailing practices of tillage, crop rotation, and fertilization are similar to those for the undulating phase. Under these practices, the following acre yields are normally obtained: Corn, 50 bushels; wheat, 20 bushels; and red clover, 1.5 tons of hay.

This soil is well suited to crops that require tillage; it is suited to more intensive use than the associated Decatur and Dunmore soils on similar slopes. Problems of controlling runoff and erosion and conserving fertility are greater than on the undulating phase of Emory silt loam. Longer rotations, a greater percentage of close-growing crops, such as small grains and legumes, and more liberal fertilization are generally required.

Fullerton silt loam, hilly phase (FH).—Residuum of moderately cherty dolomitic limestone is the material from which this soil is derived. The soil formed under a deciduous forest and has slopes of 15 to 30 percent. It occupies ridge slopes in irregularly shaped areas distributed throughout the area underlain by limestone. The larger part is in the Fullerton-stony land-Clarksville and Stony land-Fullerton-Clarksville soil associations. The soil is closely associated with Dunmore, Clarksville, Greendale, and Groseclose soils and the stony land types. Surface runoff is rapid; internal drainage, moderate.

Profile description:

0 to 8 inches, brownish-gray to grayish-brown very friable silt loam; in wooded areas the 2-inch surface layer is stained dark with organic matter.

8 to 20 inches, brownish-yellow moderately friable silty clay loam with a moderately well developed fine to medium nut structure.

20 to 40 inches, reddish-yellow to yellowish-red slightly to moderately plastic silty clay loam with a well-developed medium nut structure.

40 inches +, reddish-yellow moderately plastic silty clay streaked and splotched with gray and brown; cherty in many places; bedrock at 5 to 15 or more feet.

The soil is medium to strongly acid throughout and only moderately well supplied with organic matter and plant nutrients. Some chert—not enough to interfere with cultivation—occurs on the surface and throughout the profile in many places. Bedrock outcrops are not common. The soil is permeable to moisture, air, and plant roots. Water is readily absorbed; consequently, loss of moisture through surface runoff is not so great as on the heavier limestone soils. The water-holding capacity is moderately high. Good tilth is easily mantained.

The boundaries between this and the associated soils are indistinct in many places, and therefore small areas of associated soils are included. A few small areas containing enough chert to interfere with cultivation are also included.

Use and management.—Although all of Fullerton silt loam, hilly phase, is in forest, it is suitable for crops if farmed under a high level of management. Selection of suitable crops, suitable rotations, proper fertilization, and careful tillage are required. The soil is well suited to pasture, but lime and phosphate are required to obtain high-yielding good quality pasture. Use and management requirements for crops are similar to those for Fullerton silt loam, eroded hilly phase.

Fullerton silt loam, eroded hilly phase (FE).—This phase differs from the hilly phase chiefly in being eroded. Much of the original surface soil has been lost, and in many places the topmost part of the subsoil has been mixed with what remains of the original surface soil. The mixing has imparted a light reddish-yellow cast to the present surface layer. In most places the quantity of subsoil material incorporated into the surface layer is not enough to affect the texture and consistence, although both are slightly heavier in most places. The surface layer is brownish-gray to light reddish-yellow friable silt loam or heavy silt loam; the subsoil, reddish-yellow to yellowish-red slightly plastic silty clay loam.

This soil is distributed throughout that part of the Great Valley underlain by limestone. Much of the acreage is in the Fullerton-stony land-Clarksville and Stony land-Fullerton-Clarksville soil associations. Some small areas are included that contain chert in quantity sufficient to interfere with cultivation. Because boundaries are indistinct, some areas of the associated soils are included.

Use and management.—All of the eroded hilly phase of Fullerton silt loam is cleared; about 15 percent is in corn, 10 percent in small grains, 35 percent in hay, 25 percent in pasture, and 5 percent in miscellaneous crops. The remaining 10 percent is idle. A variety of crops are grown, generally not in any systematic rotation. Some farmers use a 4- or 5-year rotation of corn, small grains, hay, and pasture. Under the common management practice, the acre yields normally expected are 23 bushels of corn, 11 bushels of wheat, and 1 ton of red clover hay.

Since this soil is somewhat steep, difficult to work, and highly susceptible to erosion, it is not well suited to crops requiring tillage. However, slopes are not so steep nor the erosion so great as to preclude feasible tillage. Continued use for crops, however, requires careful management, including the proper selection and rotation of crops, correct fertilization, and careful tillage. Rotations should be long and consist chiefly of close-growing crops, especially grasses and legumes. Cover crops should follow intertilled crops. Lime, phosphate, and possibly potash are deficient for crops. Cultivation needs to be on the contour; contour strip cropping deserves consideration where slopes are favorable.

Fullerton silt loam, steep phase (FK).—Areas of this soil have 30- to 60-percent slopes. Like the hilly phase, this soil has a brownish-gray to grayish-brown friable silt loam surface soil and a slightly plastic reddish-yellow to yellowish-red silty clay loam subsoil. Its layers, however, are more variable in thickness and somewhat thinner.

The irregularly shaped areas are distributed throughout most of the section underlain by limestone. Closely associated are Decatur, Dunmore, Groseclose, Clarksville, Greendale, and other Fullerton soils. Considerable variation in color, depth, consistence, and chertiness occurs. The chief variation is a small acreage heavier in texture and brownish yellow rather than reddish yellow. Small areas of associated soils are included.

Use and management.—Forest now covers most of this steep phase, and even the cleared land is too steep for feasible production of field crops. Relatively high susceptibility to erosion and easily depleted virgin fertility, which is only moderate to begin with, contribute further to unsuitability for crops.

This soil is not especially productive of pasture but suitable for such use if lime and phosphate are applied. Land cleared for pasture should not be used for crops, for such use permits erosion and depletion of plant nutrients. On many farms, forest is the best use for this soil, and unless additional pasture is definitely needed, shifting from forest to pasture is not encouraged.

Fullerton silt loam, eroded steep phase (FG).—This soil differs from the steep phase chiefly in having lost a large part of the original surface soil. It has similar 30- to 60-percent slopes. Areas are widely distributed throughout the Great Valley in association with Dunmore, Clarksville, Groseclose, and Greendale soils.

The surface soil consists of brownish-gray to grayish-brown friable silt loam about 3 to 8 inches thick. In some tilled places, it has a light reddish-yellow cast owing to the incorporation of the topmost part of the subsoil. The subsoil is reddish-yellow to yellowish-red slightly plastic silty clay loam. Some included areas have strongly plastic yellow or brownish-yellow subsoil, and a small acreage differs in having lost most of the surface layers and in some places a part of the subsoil.

Use and management.—Most of Fullerton silt loam, eroded steep phase, is now used for pasture, some is in crops, and some is idle. Both crop and pasture yields are relatively low under present management. The soil is very poorly suited to crop production and only moderately suited to permanent pasture. Owing to steep slope, it is difficult to till, and in addition it is highly susceptible to erosion and moderately low in content of most plant nutrients. Fairly good pastures can be established and maintained by proper management, including applications of lime and phosphate and carefully controlled grazing.

Fullerton silt loam, eroded rolling phase (FF).—This soil of the uplands developed from the residuum of moderately cherty dolomitic limestone. It is largely on crests of ridges having 7- to 15-percent slopes. It is closely associated with Clarksville, Groseclose, Dunmore, and Greendale soils and is widely distributed in the Great Valley. The majority of the acreage is in the Fullerton-stony land-Clarksville and the Stony land-Fullerton-Clarksville soil associations. Internal and external drainage are moderate.

Profile description:

0 to 6 inches, brownish-gray to brownish-yellow or reddish-yellow friable silt loam.

6 to 18 inches, brownish-yellow moderately friable silty clay loam.

18 to 40 inches, reddish-yellow to yellowish-red slightly to moderately plastic silty clay loam with a well-developed medium nut structure.
40 inches +, reddish-yellow moderately plastic silty clay streaked and splotched with gray and brown; bedrock at 5 to 15 feet or more.

The present surface layer varies considerably in color and texture because the topmost part of the subsoil has been incorporated in some places. The entire profile is medium to strongly acid, content of organic matter is low, and supply of plant nutrients is moderately low. A few areas contain chert, but not enough to interfere with tillage. There are a few small bedrock outcrops. This soil is sufficiently friable for easy penetration of plant roots and free movement of air and moisture. Moisture is readily absorbed and well retained. The water-holding capacity is moderately high.

Boundaries between the Fullerton soils and the associated soils are not always distinct, and small areas of associated soils are included. Included also are small areas that are similar to Dunmore silty clay loam, eroded rolling phase, and Groseclose silt loam, eroded rolling phase.

The degree of erosion is variable. Under cultivation, 25 to 75 percent of the original surface soil over most of the area has been lost by accelerated erosion. A small acreage is so severely eroded that practically all of the original surface soil has been lost. With the greater loss of original surface soil, there has been a greater loss of organic matter and plant nutrients, an increase in susceptibility to erosion, a decrease in moisture absorption, and a decrease in productivity for most crops.

Use and management.—More than 90 percent of Fullerton silt loam, eroded rolling phase, has been cleared and used for crops and pasture. About 25 percent is in corn, 5 percent in wheat, 5 percent in other small grains, 5 percent in tobacco and vegetables, 30 percent in hay, and 15 percent in pasture. Approximately 15 percent of the land lies idle. A few farmers follow a 4-year rotation of corn, small grain, hay, and pasture, but systematic rotations are not generally practiced. Under common management, corn yields 33 bushels an acre; wheat, 13 bushels; tobacco, 1,000 pounds; and red clover, 1.2 tons of hay.

This soil is moderately well suited to most of the common crops, but somewhat less productive than the associated Dunmore silty clay loam, eroded rolling phase. It needs fertilization more but its tilth is easier to maintain. Like the Dunmore soil, this phase needs applications of lime and phosphate and a moderately long rotation that includes legumes and grasses. It is lower in organic matter than the Dunmore and needs more potash. The plowing under of leguminous green-manure crops is especially beneficial. So far as practicable, cultivation should be on the contour. Engineering measures for control of water are not necessary if management is otherwise good and row crops are not grown too frequently.

Fullerton silty clay loam, severely eroded hilly phase (FL).—Erosion is more severe on this soil than on the eroded hilly phase of Fullerton silt loam. Most of the original surface soil has been lost, though a layer several inches thick remains in some places. In many places the topmost part of the original subsoil has been lost. The yellowish-red to reddish-yellow subsoil is exposed in most places. Erosion is uneven, however, so areas of exposed subsoil adjoin small

patches retaining several inches of the original surface soil. Gullies, some more than 2 feet deep, are fairly common. The soil is well distributed throughout the area underlain by limestone, but most of it is in the Fullerton-stony land-Clarksville and Stony land-Fullerton-Clarksville soil associations. Mapped with this soil are areas of associated soils and small patches more sandy or cherty than normal.

Use and management.—Some areas of this soil are still used for field crops, but yields are usually very low. Other areas are in pasture, but in large part the land is idle or abandoned to a sparse cover of weeds and brush.

This soil has been severely eroded, and in its present condition is very poorly suited to field crops. Content of organic matter, supply of plant nutrients, and water-holding capacity are low; consequently, productivity is very low. The soil is relatively better suited to pasture, but that may be difficult to establish. Liberal applications of lime, phosphate, and possibly potash and nitrogen will be needed.

Fullerton loam, hilly phase (FD).—This sandy soil of the limestone valleys developed from the residuum of dolomitic limestone interbedded with fine-grained sandstone. The soil is chiefly on ridge slopes of 15- to 30-percent gradient. Native vegetation consisted mainly of deciduous trees. Areas are largely confined to the Dunmore-Fullerton-stony land and Fullerton-stony land-Clarksville soil associations. Clarksville, Groseclose, Nolichucky, Greendale, and other Fullerton soils are closely associated with this soil. Surface runoff is moderately rapid, but internal drainage is moderate.

Profile description:

0 to 8 inches, yellowish-gray very friable gritty loam; wooded areas have a thin 1- to 2-inch surface layer stained dark with organic matter.
8 to 16 inches, brownish-yellow friable light clay loam.
16 to 40 inches, yellowish-red to yellowish-brown slightly plastic silty clay loam with a well-developed medium nut structure.
40 inches +, reddish-yellow light silty clay loam streaked and splotched with gray and brown; bedrock at 5 to 15 or more feet.

The soil is medium to strongly acid throughout, moderately low in organic-matter content, moderate in supply of plant nutrients, and moderately high in water-holding capacity. Locally a few small soft sandstone fragments may be scattered over the surface and through the profile. Permeability is sufficient for penetration of plant roots and normal circulation of air and moisture. Water is readily absorbed and well retained.

Small areas of the associated Clarksville, Groseclose, Nolichucky, and other Fullerton soils cannot be separated from this soil in many places and are therefore mapped with it.

Use and management.—All of Fullerton loam, hilly phase, has the forest cover that follows incomplete harvesting of timber. The soil is moderately well suited to crops under a high level of management, but the steeper parts on many farms are probably best suited to pasture. On many farms the soil is so inaccessible that use for crops or pasture is not practical. Permanent pasture will give fair yields of fair quality forage without amendments; yields greatly increase if lime and phosphate are applied. Use and management practices for crops are similar to those for Fullerton loam, eroded hilly phase.

Fullerton loam, eroded hilly phase (FA).—The small areas of this soil are widely distributed throughout that part of the county underlain by limestone. They are closely associated with Clarksville, Groseclose, and other Fullerton soils. This phase differs from the hilly phase chiefly in being eroded. A considerable part of the original surface soil, including the thin surface layer of higher organic-matter content, has been lost. In many places the subsoil has mixed with the surface soil in the plow layer.

The present plow layer ranges from yellowish gray to brownish yellow to yellowish red. Small severely eroded spots are common and conspicuous, owing to exposure of the subsoil. On these spots the surface layer is somewhat heavier and less friable. The subsoil, like that of the hilly phase, is yellowish-red to yellowish-brown slightly plastic silty clay loam.

Use and management.—This eroded hilly soil has been cleared and used for crops and pasture. About 20 percent is in corn; 5 percent in wheat; 5 percent in other small grains, including oats and barley; 35 percent in hay; 20 percent in pasture; and 5 percent in miscellaneous crops. Approximately 10 percent of the land is idle. Prevailing practices of tillage, crop rotation, and fertilization are similar to those for the eroded rolling phase. Under common management practices, corn yields 20 bushels an acre; wheat, 8 bushels; and red clover, 0.9 ton of hay.

This soil is moderately well suited to general field crops, but less well suited than the hilly phase because it has lost part of its original surface soil. The result has been loss of organic matter and plant nutrients, increased susceptibility to erosion, and decreased productivity for most crops. Supplies of lime, nitrogen, phosphorus, and potash are moderately deficient for most crops, but a management program that includes application of these minerals brings a good response. All water-control measures consistent with good management should be followed. The use of long rotations that include a large percentage of close-growing crops, contour tillage, and, on some slopes, contour strip-cropping are desirable practices.

The steeper slopes and more severely eroded areas are probably best for pasture. Moderate to liberal applications of lime and phosphate are required for high yields.

Fullerton loam, eroded steep phase (FC).—This well-drained to excessively drained soil has developed from the residuum of dolomitic limestone interbedded with fine-grained sandstone. Slopes are steeper—30 to 60 percent—than those of the eroded hilly phase. The soil is also somewhat more variable in degree of erosion, depth to bedrock, distinctness of surface soil and subsoil layers, and number of bedrock outcrops. This soil is confined to that part of the Great Valley underlain by dolomitic limestone. It is closely associated with Clarksville, Groseclose, and other Fullerton soils, and as mapped, some areas of these soils are included.

An appreciable acreage of Clarksville soils is included that differs from the eroded steep phase in being lighter in color and cherty throughout the profile. Some uneroded as well as some severely eroded areas are also included.

Use and management.—Most of Fullerton loam, eroded steep phase, has been cleared and used for crops and pasture. About 25 percent is still in forest. A considerable cleared acreage is idle. Steep slopes and high susceptibility to erosion make this phase unsuitable for crops, but under good management most areas are suitable for permanent pasture. To establish and maintain good pasture, applications of lime and phosphate are generally required and grazing needs to be carefully controlled. On most farms some of the steeper and less accessible areas are best used for forest.

Fullerton loam, eroded rolling phase (FB).—This sandy soil of the limestone valleys developed from the residuum of dolomitic limestone and interbedded fine-grained sandstone. It differs from the eroded hilly phase chiefly in having milder slopes of 7- to 15-percent gradient. In general, it is also less eroded, deeper to bedrock, and less broken by bedrock outcrops. External and internal drainage are moderate. The soil occupies ridge crests closely associated with Clarksville, Groseclose, and other Fullerton soils and is largely confined to the Dunmore-Fullerton-stony land and Fullerton-stony land-Clarksville soil associations.

Profile description:

0 to 6 inches, yellowish-gray to brownish-yellow or reddish-yellow friable loam.
6 to 14 inches, brownish-yellow friable clay loam.
14 to 40 inches, yellowish-red to yellowish-brown slightly plastic silty clay loam.
40 inches +, reddish-yellow silty clay loam splotched with gray and brown; bedrock at 5 to 15 feet or more.

This phase is medium to strongly acid throughout, moderately low in organic-matter content, and moderately high in plant-nutrient and water-holding capacity. In some areas a few small soft sandstone fragments are scattered over the surface and throughout the profile. Permeability permits easy penetration of plant roots, air, and moisture. Water is readily absorbed and well retained.

Boundaries between this and the associated soils are not always distinct; consequently, small areas of associated soils are included. Some included areas are uneroded and others are severely eroded; some have 2- to 5-percent slopes.

Use and management.—About 20 percent of Fullerton loam, eroded rolling phase, is in corn, 5 percent in wheat, 10 percent in other small grains, 35 percent in hay, 20 percent in pasture, and 10 percent in miscellaneous crops or woods. Although a wide variety of crops are grown, systematic rotations are not commonly practiced. Some of the better farmers follow a 3- to 5-year rotation of corn, small grain, hay, and pasture. Under common management practices, the following acre yields are obtained: Corn, 33 bushels; wheat, 13 bushels; tobacco, 900 pounds; and red clover, 1.2 tons of hay.

This soil is suited to most of the common crops of the area. It is only moderately productive and many crops, however, and deficiencies in lime, phosphate, and nitrogen need to be corrected to obtain high yields. Use of lime and phosphate, growing of winter cover crops, and seeding of legumes are becoming increasingly important under a soil conservation program. Susceptibility to erosion is moderate, but contour tillage and the use of a crop rotation that includes legumes and grasses should control erosion without the use of special engineering measures.

Greendale silt loam, undulating phase (GB).—Areas of this colluvial soil are small and widely distributed throughout that part of the county underlain by limestone. The soil has formed from local alluvial or colluvial materials washed largely from Fullerton, Clarksville, and Groseclose soils. It is on gently sloping areas (2- to 7-percent slopes) at the base of slopes from which the soil material has washed. The native vegetation was chiefly deciduous forest. Surface runoff is moderate, and internal drainage is moderate to moderately slow.

Profile description:

0 to 12 inches, grayish-brown to brownish-gray friable silt loam.
12 to 20 inches, yellowish-brown friable silt loam or light silty clay loam.
20 to 32 inches, brownish-yellow friable silt loam or silty clay loam lightly splotched with gray.
32 inches +, brownish-yellow silty clay loam or clay loam splotched with gray; depth of accumulation ranges from 2 to 10 feet.

This phase is medium acid, moderately well supplied with organic matter, moderately high in plant nutrients, and high in water-holding capacity. Although it is virtually stone- and chert-free, some areas have a few small chert fragments on the surface and through the soil mass but not in sufficient quantity to interfere with tillage. The soil is permeable to plant roots, air, and moisture. Water is readily absorbed and well retained.

Characteristics vary somewhat from place to place owing to differences in parent material, depth of accumulation, texture, and drainage. As mapped, this phase includes soils not only at the base of slopes but also along narrow bottomlike areas along intermittent drainageways and on small alluvial-colluvial fans formed by deposits left by small streams on the flood plains of larger streams.

Use and management.—Practically all of Greendale silt loam, undulating phase, has been cleared and cultivated. About 30 percent is in corn, 20 percent in small grains, 40 percent in hay and pasture, and 10 percent in miscellaneous crops, including tobacco. This soil is used intensively for crop production, and crops are not usually rotated. It is one of the best soils of the county for tobacco. Many farmers do not use fertilizer on all crops. Acre yields of 45 bushels of corn, 18 bushels of wheat, 1,650 pounds of tobacco, and 1.4 tons of red clover hay are obtained under ordinary management practices.

This soil is well suited to tilled crops and will stand intensive cropping. It has very low susceptibility to accelerated erosion, and control of runoff or erosion is a minor problem. Yields of most crops are relatively high and can become higher if deficiencies in lime, phosphate, and, in most places, nitrogen are overcome. With proper fertilization, yields probably can be maintained a long time under continuous cropping. Nonetheless, on most farms the use of a short rotation that includes red clover or some other legume is better. Although the soil is fairly well suited to most crops, it is not so suitable for alfalfa as the Decatur, Dunmore, and similar soils of the uplands.

Greendale silt loam, rolling phase (GA).—Steeper slopes (7- to 15-percent gradient) are the chief difference between this and the undulating phase. Like that soil, this one has a grayish-brown or brownish-gray friable silt loam or light silty clay loam surface layer, but its depth of colluvial material is somewhat more variable and generally shallower. The very small areas of this phase are widely

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distributed in that part of the county underlain by limestone. Closely associated are the Fullerton, Clarksville, Groseclose and Lindside soils.

Use and management.—Practically all this rolling phase has been cleared. About 25 percent is in corn, 15 percent in small grains, 45 percent in hay and pasture, and 10 percent in other crops. The remaining 5 percent of the land is idle. Use and management practices are similar to those for the undulating phase, but yields average somewhat less. Under common management, 40 bushels of corn, 16 bushels of wheat, 1,450 pounds of tobacco, and 1.3 tons of red clover hay are average acre yields.

This soil is well suited to tilled crops, especially tobacco. It is suited to more intensive use than the associated Fullerton, Clarksville, and Groseclose soils, but owing chiefly to stronger slope, it is less well suited than the undulating phase. Use and management requirements are similar to those for the undulating phase, but crop rotations and fertilization are more essential if yields are to be maintained or increased. It is slightly susceptible to erosion, and such practices as contour tillage and use of cover crops after intertilled crops are desirable.

Groseclose silt loam, eroded rolling phase (Gd).—This heavy well-drained soil of the limestone valleys has developed from the residuum of clayey dolomitic limestone on 7- to 15-percent slopes. Native vegetation consisted largely of deciduous forest. Areas are chiefly on crests of low ridges or ridge slopes in the less dissected parts of the Fullerton stony land-Clarksville and the stony land-Fullerton-Clarksville soil associations. The Fullerton, Clarksville, Dunmore, Greendale, and Lindside are closely associated soils.

Profile description:

0 to 6 inches, gray friable silt loam.
6 to 10 inches, brownish-gray moderately friable silt loam or silty clay loam.
10 to 26 inches, yellowish-brown to brownish-yellow moderately to strongly plastic silty clay with a well-developed medium to coarse blocky structure.
26 inches +, brownish-yellow to reddish-yellow moderately plastic silty clay or silty clay loam streaked and splotched with yellow; bedrock at 5 to 10 feet.

The entire profile is medium to strongly acid, the content of organic matter is relatively low, and the supply of plant nutrients is moderately low. In local areas a few small angular chert fragments are scattered over the surface and through the profile, but they are not sufficiently numerous to interfere materially with tillage operations. Bedrock outcrops occasionally, and thin flakes and bands of partly disintegrated shale fragments are common in the lower layers. This soil is sufficiently friable for satisfactory plant-root penetration and normal circulation of air and moisture. Water absorption is slightly restricted, and water-holding capacity is moderately low.

A considerable part of the original surface layer has been lost from many areas as a result of erosion; the subsoil has mixed with the remnants of the surface soil in the plow layer so that the present surface layer ranges from gray to brownish-yellow and from silt loam to silty clay loam.

Included with this soil are small areas of associated Dunmore, Fullerton, and Clarksville soils, the boundaries of which were not dis-

tinct. Some small uneroded areas are also included, as well as a few areas that have milder slopes of 2 to 7 percent.

Use and management.—Most of Groseclose silt loam, eroded rolling phase, has been cleared and cultivated. Of the cleared area, about 25 percent is in corn, 20 percent in small grains, 40 percent in hay and pasture, 10 percent in miscellaneous crops, and 5 percent is idle. About 15 percent of the total area is in cut-over forest.

Although a variety of crops is grown, they are not systematically rotated and fertilizer is not commonly used for all of them. Under common practices, the following acre yields are obtained: Corn, 30 bushels; oats, 23 bushels; wheat, 11 bushels; red clover, 1.3 tons of hay; and lespedeza, 0.9 ton of hay.

This soil is suited to crops, but its productivity is low for many of them because of moderately low plant-nutrient content, and water-holding capacity. Maintaining or increasing crop yields generally requires adequate fertilization and a moderately long rotation that includes close-growing crops (preferably deep-rooted legumes). The soil is deficient in lime, phosphate, nitrogen, and possibly potash for many crops. It is susceptible to erosion, and contour tillage is desirable.

Groseclose silt loam, eroded hilly phase (Gc).—This soil has developed from the residuum of clayey dolomitic limestone. It differs from the eroded rolling phase chiefly in having steeper slopes (15 to 30 percent), but like that soil, a considerable part of the original surface soil has been removed by erosion. Surface runoff is rapid, and internal drainage is moderately slow. The soil is distributed throughout that part of the county underlain by limestone but is most common in the area south of Elizabethton. It is closely associated with Fullerton, Dunmore, Clarksville, Greendale, and Lindside soils.

The present surface layer ranges from gray to brownish yellow and from silt loam to silty clay loam. Small severely eroded spots are common and conspicuous owing to exposure of the yellowish-brown subsoil.

The soil is medium to strongly acid. The quantity of organic matter is relatively low, plant-nutrient content is moderately low, and water-holding capacity is moderate to low. A few small angular chert fragments may be on the surface and in the profile, but they do not interfere with cultivation. There are a few bedrock outcrops. This soil is only slightly permeable, and plant root penetration and circulation of air and moisture are somewhat restricted.

Boundaries between this phase and the associated Dunmore, Fullerton, and Clarksville soils are not always distinct; consequently, small areas of these associated soils are included. Some uneroded areas are also included.

Use and management.—Most of the eroded hilly phase of Groseclose silt loam has been cleared and used for crops and pasture for many years. An estimated 20 percent is in corn, 15 percent in small grains, 50 percent in hay and pasture, and 5 percent in miscellaneous crops. About 10 percent of the land lies idle. Crops are usually not rotated, but a few farmers follow a 4- or 5-year rotation of corn, small grain, hay, and pasture. Some crops receive light applications of fertilizer.

Although this soil is commonly used for field crops, it is better suited to permanent pasture or semipermanent hay crops. Chiefly be-

cause slopes are stronger, the problem of conservation is greater than on the eroded rolling phase. Erosion is very difficult to control on clean-cultivated fields. Very good pasture can probably be established and maintained under a high level of management, especially one that includes application of lime and phosphate.

Hamblen loam (HA).—This bottom-land soil consists of mixed general alluvium washed from uplands underlain by calcareous shale, slate, quartzite, and sandstone. The alluvial deposit is 3 to more than 10 feet in depth. Although areas are widely distributed over the northwestern part of the county, the larger and more typical ones are in the Dandridge-Hamblen soil association. The soil occupies narrow elongated areas closely associated with Dandridge, Litz, Teas, Staser, and Leadvale soils. Slow external and internal drainage are the chief differences between this soil and Staser fine sandy loam.

Profile description:

0 to 14 inches, brownish-gray to grayish-brown very friable loam.
14 to 30 inches, grayish-yellow friable loam to clay loam, splotched and mottled with gray, yellow, and brown.
30 inches +, friable sandy clay loam highly mottled with rust brown, yellow, and gray.

The soil is medium to slightly acid, moderately well supplied with organic matter and plant nutrients, and relatively free of stones or gravel. It is very permeable and permits easy penetration of plant roots and good circulation of air and moisture when not saturated with water. Rainfall is readily absorbed and well retained. The water-holding capacity is relatively high. The soil is on nearly level flood plains, and much of it is subject to overflow.

As mapped, this soil includes many small variations. Some small included areas are poorly drained; others are well drained. The texture ranges from silt loam to fine sandy loam. Some of the included areas differ from this soil chiefly in being strongly acid.

Use and management.—Nearly all of Hamblen loam is cleared. It is used chiefly for corn but to some extent for hay and pasture. Yields are highly variable, but in general those of corn and of many hay and forage crops are relatively high.

Chiefly because of inferior drainage, this soil is not so well suited to crops as Staser fine sandy loam. Corn frequently has to be planted later in spring and is more susceptible to injury from wetness. Hay and pasture plants moderately tolerant of wetness are about equally suited to this soil and the Staser.

In some areas this soil is especially valuable for pasture because it remains moist and productive through extended dry periods when pasture on upland soils becomes scant. Drainage is generally inadequate for alfalfa; small-grain crops are not considered well suited. Artificial drainage should broaden use suitability to some extent. Ordinarily, lime is needed only on the strongly acid variations; phosphorus and nitrogen are the elements most likely to be needed.

Hayter loam, rolling phase (HB).—This well-drained colluvial soil has formed from material washed from uplands underlain largely by quartzite, influenced by or mixed with material from limestone or other calcareous rocks. The colluvial deposit ranges from 3 to 10 or more feet. It is chiefly from Ramsey soils, but in most places it includes some material from Dunmore and Decatur soils. Areas are

below and in some places adjacent to outcroppings of limestone and are very likely influenced by lime-bearing water. Slopes range from 7 to 15 percent. This phase is in small areas closely associated with Decatur, Dunmore, Emory, Sequatchie, Jefferson, and Allen soils. Most areas are either in the Decatur-Dunmore-stony land or Jefferson-Allen-Sequatchie soil associations.

Profile description:

0 to 12 inches, grayish-brown very friable loam.
12 to 30 inches, yellowish-brown friable silty clay loam with weak medium blocky structure.
30 inches +, yellowish-brown to brownish-yellow friable sandy clay loam.

This soil is medium acid, high in plant nutrients, and well supplied with organic matter. Some areas have a few small standstone rock fragments on the surface and throughout the soil, but these do not interfere materially with tillage. The lower soil layers are stony or gravelly in many places. The soil is very permeable to plant roots, air, and moisture. Water is readily absorbed, and water-holding capacity is high.

Small areas of Emory silt loam soil, Sequatchie loam, and other Hayter soils are included. A small acreage is included that has a steeper slope of 15 to 30 percent.

Use and management.—Practically all areas of Hayter loam, rolling phase, have been cleared and cultivated. About 25 percent is in corn, 20 percent in small grains, 40 percent in hay and pasture, and 10 percent in miscellaneous crops including tobacco. The rest is idle. Systematic crop rotations are not commonly used, but some farmers use a 3-year rotation of corn, small grains, and hay.

Acre yields under common management practices are: Corn, 40 bushels; oats, 35 bushels; wheat, 15 bushels; barley, 30 bushels; lespedeza hay, 1.3 tons; sweetclover hay, 1.4 tons; clover and timothy hay mixed, 1.3 tons; white potatoes, 110 bushels; and tobacco, 1,400 pounds.

This soil is well suited to crops (including tobacco, alfalfa, and truck crops) and pasture. It is naturally relatively fertile, but crops respond well to fertilizer and lime. If tilth and moisture relations are favorable, large yields can be consistently produced when supplies of plant nutrients, lime, and organic matter are maintained at a high level. The soil is slightly susceptible to erosion, but it can be maintained in a crop rotation of moderate length if contour farming is practiced.

Hayter loam, undulating phase (Hc).—This well-drained soil is at the base of long steep upland slopes on terrace-like positions between small streams. It differs from the rolling phase chiefly in having milder slopes (2 to 7 percent) but is also slightly darker in color, somewhat higher in organic matter and plant nutrients, slightly thicker, and less susceptible to erosion. It has brown or grayish-brown very friable loam surface soil and yellowish-brown friable silty clay loam subsoil. Areas are closely associated with Decatur, Dunmore, Emory, Sequatchie, Jefferson, and Allen soils. Most of it is in the Decatur-Dunmore-stony land and Jefferson-Allen-Sequatchie soil associations.

Use and management.—An estimated 30 percent of this undulating phase is in corn, 20 percent in small grains, 35 percent in hay and

pasture, and 10 percent in miscellaneous crops. About 5 percent of the land is left idle. Rotations are short and irregular. Row crops are grown at frequent intervals. Tobacco is fertilized heavily; other crops receive moderate to light fertilization, or none. Acre yields are relatively high under common management practices: Corn, 45 bushels; wheat, 20 bushels; tobacco, 1,600 pounds; and red clover hay, 1.6 tons.

This soil is well suited to intensive use for crops, including tobacco, alfalfa, and truck crops. It is productive, easy to work, and its fertility and soil material are not difficult to conserve from losses by erosion and leaching. Although good yields can ordinarily be obtained without amendments, some fertilization and liming are needed to maintain high yields.

Hayter stony loam, rolling phase (HD).—This soil has formed from local alluvium and colluvium washed chiefly from Ramsey, Decatur, and Dunmore soils. It differs from Hayter loam, rolling phase, chiefly in having more stones in the surface and throughout the soil mass. Slopes range from 7 to 15 percent. The small elongated areas are closely associated with Decatur, Dunmore, Allen, and Jefferson soils. Most of the acreage is in the Decatur-Dunmore-stony land and Jefferson-Allen-Sequatchie soil associations. Surface runoff is moderate, and internal drainage is moderately rapid.

Profile description:

0 to 12 inches, grayish-brown very friable stony loam.
12 to 24 inches, yellowish-brown friable stony silty clay loam.
24 inches +, brownish-yellow friable stony clay loam or sandy clay loam.

This soil is medium acid, well supplied with organic matter, and relatively high in content of most plant nutrients. Small angular and subangular sandstone fragments and cobblestones are scattered over the surface and throughout the soil mass in numbers sufficient to interfere with tillage. The soil is very permeable and permits easy penetration of plant roots and normal circulation of air and moisture. Water is readily absorbed, and water-holding capacity is high.

Part of the original surface soil has been lost as a result of accelerated erosion in some places, but enough remains in practically all areas to form all the plow layer. Although the present surface layer may be slightly heavier because of the loss, neither color nor texture has been affected.

Use and management.—Practically all of Hayter stony loam, rolling phase, has been cleared and used for crops and pasture. About 20 percent is used for corn; 20 percent for small grains; 30 percent for hay; 15 percent for pasture; 10 percent for miscellaneous crops, including tobacco and truck crops; and 5 percent is idle. Yields of all crops are good, and under average management corn produces 30 bushels an acre; tobacco, 1,200 pounds; and red clover hay, 1.2 tons. The few farmers that use adequate quantities of fertilizer and practice crop rotation obtain notably higher yields.

This relatively fertile soil is suitable for crops and pasture. Owing to stoniness, which interferes with tillage of crops and clipping of pasture, it is less desirable than Hayter loam, rolling phase. Susceptibility to erosion is slight. If fertility is maintained and lime added, the more exacting small-grain, hay, and pasture crops, such as red clover, alfalfa, white clover, are suited. Chiefly because of favorable

moisture conditions, pasture vegetation is maintained during dry periods better than on the associated upland soils.

Hayter stony loam, undulating phase (HE).—The milder slopes of this phase (2 to 7 percent) are the chief difference between it and the rolling phase. In most places, however, the colluvial deposit of this soil is deeper, the soil layers are thicker, and less of the surface soil has been lost as a result of erosion. Stone content, like that of the rolling phase, is sufficient to interfere with cultivation. The surface soil is brown or grayish-brown very friable stony loam, and the subsoil is yellowish-brown friable stony silty clay loam. Areas are closely associated with Jefferson, Allen, Emory, Sequatchie, Decatur, and Dunmore soils.

Use and management.—This undulating phase has practically all been cleared and used for crops and pasture. It is used in short irregular rotations; row crops are grown at frequent intervals. Tobacco is heavily fertilized, but other crops receive only light applications or none at all. Yields are relatively high even under prevailing management practices: Corn, 35 bushels an acre; tobacco, 1,300 pounds; and red clover hay, 1.3 tons.

This soil is well suited to intensive cropping, and its fertility and high water-holding capacity make it productive of most crops, especially tobacco and vegetables. Some lime and phosphate are generally required for the successful growth of deep-rooted legumes such as red clover and alfalfa. The soil is slightly deficient in lime, phosphate, nitrogen, and possibly potash for maximum production of many crops. It is not difficult to conserve fertility or soil material from losses caused by erosion and leaching.

Hiwassee clay loam, eroded undulating phase (HH).—This well-drained soil occupies old high stream terraces, most of which are 50 to 150 feet above the present flood plain. The parent material consists principally of old alluvium washed largely from uplands underlain by granite, but in most places includes an admixture of material from sandstone, quartzite, shale, and slate. These stream terrace deposits are largely underlain by limestone or calcareous shale at depths of 8 to 20 feet or more. Slopes range from 1 to 5 percent. Practically all of the soil is in the Hiwassee-Masada-Altavista association, closely associated with Masada, Nolichucky, Fullerton, Dunmore, Allen, and other Hiwassee soils.

Profile description:

0 to 8 inches, brown to reddish-brown friable clay loam; in wooded areas, to a depth of about 2 inches, layer is dark grayish-brown and high in content of organic matter.

8 to 40 inches, red or reddish-brown friable clay loam or silty clay loam with a moderately well developed medium blocky structure.

40 inches +, reddish-brown to brownish-yellow moderately friable clay loam faintly splotched with yellow and brown in lower part; in most places more than 10 feet deep.

The soil is medium to strongly acid, moderate in content of organic matter, and moderately high in supply of plant nutrients. A few to many small cobblestones are on the surface. Some areas are virtually cobble-free; others have cobblestones in numbers sufficient to interfere materially with cultivation. Characteristically the soil is cobbly throughout its mass, especially at depths below 2 or 3 feet

(pl. 4, *A*). Moisture and air permeate easily, and roots penetrate freely. Rainfall is readily absorbed, and water-holding capacity is high.

A considerable part of the original surface layer has been eroded away. There has been some mixing of the subsoil with the remnants of the original surface soil, and the present surface layer varies greatly in color (brown to reddish brown) and texture (loam to clay loam) within short distances. Small severely eroded spots are commonly conspicuous because the subsoil has been exposed.

As mapped, this soil includes a few acres of gravelly soil similar in profile characteristics but formed from materials that were washed from uplands underlain by sandstone and shale. Small areas of associated soils and some uneroded areas are also included.

Use and management.—Most of Hiwassee clay loam, eroded undulating phase, has been cleared and cultivated. About 50 percent, however, is within the city limits of Elizabethton and is consequently used only for home sites or gardens. Of the land used for agriculture, about 25 percent is in corn, 15 percent in small grain, 30 percent in hay, 10 percent in pasture, 10 percent in other crops—including tobacco. About 10 percent is in other nonfarm uses or left idle. Crops are not systematically rotated, although a variety are grown. Some farmers use a 3- or 4-year rotation of such crops as corn, small grain, red clover, and grass.

Tobacco and vegetable crops receive moderately heavy applications of a complete fertilizer on most farms; other crops receive only light applications, if any. Application of lime and phosphate to hay and pasture crops has become common recently. Under common management, corn yields 40 bushels an acre; tobacco, 1,550 pounds; and red clover hay, 1.5 tons.

This phase is easy to work and conserve, productive of the crops commonly grown, and well suited to all common field crops, including alfalfa. It is favorable in slope, fertile, and high in water-holding capacity; consequently, it is suited to somewhat intensive use. It is slightly deficient in lime, phosphate, and nitrogen for maximum production of some crops, especially red clover and alfalfa.

Hiwassee clay loam, eroded rolling phase (HG).—The alluvium from which this soil formed has washed largely from Porters, Ashe, or other soils derived from granite and gneiss. In most places, however, it contains an admixture of material from quartzite, sandstone, shale, and slate. The soil differs from the eroded undulating phase chiefly in having steeper slopes (5 to 15 percent). Practically all of this soil is on high terraces of the Watauga and Doe Rivers and is largely confined to the Hiwassee-Masada-Altavista soil association. It is associated with Masada, Altavista, Fullerton, Dunmore, Allen, and other Hiwassee soils. Internal and external drainage are moderate.

The surface soil ranges from brown to reddish brown and from loam to clay loam. The subsoil consists of red or reddish-brown friable clay loam or silty clay loam.

The soil is medium to strongly acid, and the quantity of organic matter is moderate. A few medium to small cobblestones are on the surface and throughout the soil mass. Locally, small areas may be virtually cobble-free, whereas others are sufficiently cobbly to inter-

fere with tillage. The soil is permeable and permits easy plant root penetration and normal circulation of air and moisture. Rainfall is readily absorbed, and water-holding capacity is high.

As mapped, this soil includes a small acreage of gravelly soil that is similar in many profile characteristics but has parent materials washed largely from uplands underlain by sandstone and shale. Small areas of associated soils and a few small uneroded areas are also included.

Use and management.—About 30 percent of Hiwassee clay loam, eroded rolling phase, is within the city limits of Elizabethton and is therefore not a part of any farm. Some of the soil in the city is used for home gardens. Of the land in farms, about 20 percent is in corn, 15 percent in small grains, 25 percent in hay, 15 percent in pasture, and 10 percent in other crops; 15 percent is idle or in other nonfarm uses. Cropping and fertilization practices are similar to those of the eroded undulating phase. Acre yields under common management are 35 bushels of corn, 1,400 pounds of tobacco, and 1.4 tons of red clover.

This soil is inferior to the eroded undulating phase because it is more steeply sloping and more susceptible to erosion. Like that soil it is fertile, high in water-holding capacity, and productive of most crops grown in the county. To maintain or increase productivity, a longer crop rotation that includes more close-growing crops is required, and probably somewhat heavier fertilization. Terraces or other special engineering devices should be effective if properly laid out and constructed; they are necessary if the rotation includes many row crops. Contour tillage should be practiced wherever feasible, and this, in addition to proper rotation and fertilization, may be all the water control necessary.

Hiwassee clay loam, eroded hilly phase (HF).—This soil differs from Hiwassee clay loam, eroded undulating phase, chiefly in having much steeper slopes (15 to 30 percent). In general, it is more variable in color, texture, stoniness, and depth; surface runoff is more rapid; and on most areas more of the original surface soil has been lost. Small severely eroded spots are common. The surface soil is brown to reddish-brown loam or clay loam; the subsoil, red or reddish-brown friable clay loam or silty clay loam. The soil formed from old alluvium washed chiefly from uplands underlain by granite and gneiss, but some included areas are predominantly from quartzite and slate. Most of this soil is on high terraces of the Doe and Watauga Rivers, closely associated with Masada, Altavista, Fullerton, Dunmore, Allen, and other Hiwassee soils.

Use and management.—All of Hiwassee clay loam, eroded hilly phase, has been cleared and cultivated. It is used for general field crops and pasture. About 15 percent is in corn, 15 percent in small grain, 20 percent in hay crops, 25 percent in pasture, and 5 percent in other crops. About 20 percent is idle or in nonfarm uses. Many different crops are grown but they are not systematically rotated. The small acreage of tobacco and truck crops generally receives heavy applications of a complete fertilizer; most other crops receive little or no fertilizer. Under ordinary management, corn yields 30 bushels an acre; wheat, 13 bushels; and red clover hay, 1.2 tons.

This soil, though moderately well suited to crops requiring tillage, is somewhat restricted in suitability by its eroded condition and sus-

ceptibility to further erosion. Choice and rotation of crops, tillage practices, fertilization, and other measures of water control are more exacting than on the eroded rolling phase. Longer rotations that include a greater percentage of close-growing crops, the return of more organic matter in the form of leguminous green-manure crops, and contour tillage are necessary to maintain productivity. The steeper more eroded areas are probably better suited to hay crops or permanent pasture.

Holston fine sandy loam, eroded rolling phase (Hm).—Most of this soil of old stream terraces is 75 to 150 feet above the present flood plain and has formed from mixed materials washed from uplands underlain largely by quartzite, sandstone, and shale. Slopes range from 5 to 15 percent. Areas are closely associated with Nolichucky, Fullerton, Jefferson, Allen, and other Holston soils. Surface drainage is moderate, but internal drainage is moderately slow.

Profile description:

0 to 8 inches, gray or yellowish-gray very friable fine sandy loam.
8 to 30 inches, yellow moderately firm but friable sandy clay loam or clay loam.
30 inches +, yellow moderately compact sandy clay or sandy clay loam, highly mottled with gray and brown; the alluvial deposit ranges from 5 to 15 or more feet in thickness.

Reaction is strongly acid, organic-matter content is low, and plant-nutrient content is moderately low. The soil is characteristically somewhat stony on the surface and throughout the soil mass; locally, however, there are stone-free areas. Thin beds of gravel or cobbles may be at various depths within the soil mass, but they are more likely to be near the base of the deposit. The soil is sufficiently permeable to plant roots, air, and moisture. Water is readily absorbed by the surface and subsurface layers, but the compact substratum tends to retard the absorption and movement of soil water.

This soil is moderately eroded, and in most places a considerable part of the original surface layer has been lost. There has been some mixing of the surface soil and subsoil in the plow layer, but the texture is not significantly heavier except in the more severely eroded spots. Small severely eroded spots are common and conspicuous, owing to exposure of the yellow subsoil.

As mapped, this soil includes small areas of associated Nolichucky, Fullerton, and Jefferson soils. Some uneroded areas, as well as a few severely eroded areas, are also included. Some included areas have 1- to 5-percent slopes.

Use and management.—Practically all of Holston fine sandy loam, eroded rolling phase, has been cleared and used for crops or pasture. About 20 percent is used for corn, 10 percent for small grains, 30 percent for hay crops, and 20 percent for pasture. Approximately 20 percent is in other crops or is idle land. A number of crops are grown but generally are not systematically rotated. Truck crops and tobacco are usually heavily fertilized, but fertilization of other crops is not common. Under ordinary management, corn produces 18 bushels an acre; wheat, 8 bushels; and tobacco, 525 pounds.

This soil is well suited to crops but only moderately responsive to good management. Fertility is somewhat difficult to maintain, but good tilth is easily maintained and erosion control is not a serious prob-

lem. Wheat and similar small grains do well; corn does fairly well but generally produces low yields; hay crops, except alfalfa, can be successfully grown; and truck crops (as potatoes) and tobacco grow well.

For the successful production of crops, fertilization is necessary because the soil is low in organic matter, lime, phosphate, potash, and nitrogen. In most places the soil is susceptible to erosion, and therefore cultivation should be on the contour. A rotation of at least moderate length is needed under ordinary conditions.

Holston cobbly fine sandy loam, eroded rolling phase (HL).—This well-drained cobbly soil occupies areas 75 to 150 feet above the present flood plain. Its parent materials have washed from uplands underlain by quartzite, sandstone, and shale. In distribution and associations the soil is similar to Holston fine sandy loam, eroded rolling phase, but it differs in being more cobbly. Slopes range from 7 to 15 percent.

Profile description:

0 to 8 inches, gray to yellowish-gray very friable cobbly fine sandy loam.
8 to 30 inches, yellow moderately firm but friable cobbly sandy clay loam or clay loam.
30 inches +, yellow moderately compact sandy clay or sandy clay loam highly mottled with gray and brown; alluvial deposit ranges from 5 to 15 feet or more thick.

The soil is strongly acid, low in organic matter, and moderately low in plant nutrients and water-holding capacity. Cobblestones in the plow layer interfere materially with tillage, and the soil is also cobbly throughout its mass. Permeability to plant roots, air, and moisture is sufficient. Rainfall is readily absorbed.

Use and management.—Most of Holston cobbly fine sandy loam, eroded rolling phase, is used for hay or pasture, but some is used for crops, and a considerable acreage is idle. Crop and pasture yields are low.

This soil is inferior to Holston fine sandy loam, eroded rolling phase, for crops, chiefly because it contains so many cobblestones. The cobblestones interfere with tillage of intertilled crops, clipping of pasture, and harvesting of small grains and other close-growing crops. Fertilization is essential for most crops. Susceptibility to erosion is moderate. Excessive soil loss can be prevented by using contour tillage and a crop rotation of moderate length.

Holston cobbly fine sandy loam, eroded hilly phase (HK).—The old alluvium from which this light-colored well-drained cobbly soil of the high stream terraces formed has washed largely from Ramsey and associated soils. The soil differs from Holston cobbly fine sandy loam, eroded rolling phase, chiefly in having steeper slopes (15 to 30 percent). It is more variable in such characteristics as color, texture, and content of cobblestones and gravel. The surface soil is gray or yellowish-gray very friable cobbly fine sandy loam; the subsoil, yellow cobbly sandy clay loam or clay loam. In distribution and association this soil is similar to the eroded rolling phase.

Use and management.—Most of this eroded hilly soil is used for pasture, but some is in crops, and a considerable part is idle. Strong slopes and high content of cobbles make the soil difficult to till, and on most farms it is probably best used for pasture. In most places

moderate to heavy applications of lime and phosphate are necessary to obtain pasture of even fair quality. Weeds are difficult to control because the large cobblestones usually prevent clipping. Some included areas are not cobbly and possibly can be used for crops grown in a long rotation.

Jefferson fine sandy loam, eroded rolling phase (JA).—The local alluvium or colluvium from which this soil has formed has washed largely from the Ramsey soils of the uplands. In most places this material is spread out a considerable distance over the valley floor. The soil occupies gently sloping to sloping areas of 2- to 15-percent gradient at the base of the upland slopes from which the material has washed. It occurs in small irregularly shaped areas closely associated with Allen, Sequatchie, and other Jefferson soils. Surface runoff is slow to moderate, and internal drainage is moderate.

Profile description:

0 to 8 inches, yellowish-gray very friable fine sandy loam; wooded areas have a thin surface layer stained dark with organic matter.
8 to 28 inches, grayish-yellow to brownish-yellow friable sandy clay loam.
28 inches +, brownish-yellow to reddish-yellow moderately friable sandy clay mottled with gray, brown, and yellow; accumulation ranges from about 4 to 20 feet deep.

The soil is strongly acid and low in organic matter and plant nutrients. It is permeable and permits easy penetration of plant roots and normal circulation of air and moisture. A few stones are on the surface and throughout the soil mass, but they do not interfere materially with cultivation.

Most areas are moderately eroded and have lost a considerable part of the original surface soil. There has been some mixing of surface soil with the subsoil in places, and the present surface layer is highly variable in thickness, color, and texture.

As mapped, a few small areas of associated soils are included, as well as a few very small stony areas.

Use and management.—Jefferson fine sandy loam, eroded rolling phase, has been mostly cleared and placed under cultivation. An estimated 20 percent is in corn, 15 percent in small grains, 30 percent in hay crops, 15 percent in pasture, and 10 percent in other crops. About 10 percent is idle or in nonfarm uses. A variety of crops are grown in a very irregular rotation. Tobacco and truck crops are generally heavily fertilized, but other crops receive only light applications if fertilized at all. Under common management acre yields of corn are 18 bushels; wheat, 8 bushels; and red clover hay, 1 ton.

This phase is moderately well suited to crops and pasture. Naturally low fertility and moderately low water-holding capacity make yields of most crops low. The soil is deficient in lime, phosphate, nitrogen, and potash for most crops and highly deficient for some. It responds well to application of these plant nutrients. It is not highly susceptible to erosion and can be maintained under a moderately short rotation if properly fertilized and tilled on the contour.

Jefferson stony fine sandy loam, rolling phase (JL).—This well-drained soil of the colluvial lands is at the base of steep mountain slopes or spread out a short distance over the valley floor. It has formed from materials washed or rolled from uplands underlain by

quartzite, sandstone, shale, and slate. Most of the material is from Ramsey soils. Slopes range from 7 to 15 percent. Areas are relatively small and are associated with Ramsey, Allen, and other Jefferson soils.

Profile description:

0 to 8 inches, yellowish-gray very friable stony fine sandy loam; thin 1- to 2-inch surface layer is stained dark with organic matter in most places.
8 to 24 inches, grayish-yellow to brownish-yellow friable stony sandy clay loam or clay loam.
24 inches +, brownish-yellow friable stony sandy clay loam, mottled with gray, red, and brown in most places; colluvial deposit ranges from 3 to 15 feet or more deep.

The soil is strongly acid, apparently low in organic matter and plant nutrients, and very permeable to air, roots, and water. It absorbs moisture readily, but its moisture-holding capacity is low. A few to many rounded and angular stones 5 to 10 inches in diameter are on the surface and throughout the soil. These stones materially interfere with cultivation.

Use and management.—All of this soil is in forest. It is suited to crops and pasture, but its low fertility, stoniness, slope, and, on many farms, small size and inaccessibility limit its usefulness. It is deficient in most of the essential plant nutrients and in water-holding capacity, and therefore it would be low-yielding for pasture or most crops. Most common crops of the area can be grown, but tobacco, red clover, alfalfa, and similar crops would require very heavy fertilization for successful growth.

Jefferson stony fine sandy loam, eroded rolling phase (JG).—Its considerable loss of surface soil through erosion distinguishes this soil from the rolling phase. The original surface layer still constitutes the plow layer over most of the area, but in small patches there has been some mixing of subsoil and surface soil. The present surface layer is yellowish-gray to grayish-yellow stony fine sandy loam; and the subsoil, brownish-yellow friable stony fine sandy loam. The soil is on rolling areas (7- to 15-percent slopes) of alluvial-colluvial material below and adjacent to areas of hilly and steep Ramsey soils. It is closely associated with Ramsey, Allen, and other Jefferson soils.

Use and management.—All areas of this eroded rolling phase have been cleared and cultivated. About 20 percent is in corn, 15 percent in small grains, 30 percent in hay crops, 25 percent in pasture (pl. 4, *B*), and 10 percent in other crops or left idle. A number of crops are grown in very irregular rotation. Tobacco and truck crops are usually heavily fertilized, but other crops receive only light applications if fertilized at all. Under common management, corn yields 10 bushels an acre; wheat, 5 bushels; tobacco, 300 pounds; and red clover hay, 0.8 ton.

The soil is moderately well suited to crops and pasture but not naturally productive of them. Low fertility, low water-holding capacity, stoniness, and slope greatly limit its usefulness. It is deficient in the major plant nutrients for practically all crops. Fertilization is necessary for good yields of most crops, and heavy applications of lime and fertilizer are required to maintain stands of alfalfa, red clover, and other legumes. Susceptibility to erosion is moderate, and some special effort is required to control water on the land.

Jefferson stony fine sandy loam, undulating phase (Jn).—This light-colored stony soil of the gently sloping colluvial lands has formed at the base of hilly or steep slopes from material washed from Ramsey and associated soils of the uplands. It differs from the rolling phase chiefly in having milder slopes (2- to 7-percent). Both internal and external drainage are moderate. The surface soil is yellowish-gray very friable stony fine sandy loam; and the subsoil, brownish-yellow friable stony sandy clay loam. The relatively small areas are associated with Allen and Ramsey soils and other members of the Jefferson series.

The soil is strongly acid and apparently low in organic matter and plant nutrients. It absorbs water readily but has a moderately low water-holding capacity. It is very permeable to air, roots and water. Many rounded and angular stones, 5 to 8 inches across, are on the surface and throughout the soil. Stoniness materially interferes with tillage. Some areas are included that have lost a considerable part of the original surface soil.

Use and management.—All but a very small part of Jefferson stony fine sandy loam, undulating phase, is cleared and used either for crops or pasture. About 20 percent is used for corn, 15 percent for small grains, 30 percent for hay crops, and 20 percent for pasture. Some 15 percent is in other crops or left idle. Corn, hay, and small-grain crops are rotated irregularly. Tobacco receives heavy applications of fertilizer; other crops, little or none. A few hay crops and pastures have been limed and phosphated in recent years. Under ordinary management, corn yields 18 bushels an acre; wheat, 6 bushels; and tobacco, 450 pounds.

This soil is suited to practically all of the commonly grown crops and pasture. It is low in productivity but responds well to good management. Water is easily controlled. The supply of lime and most plant nutrients is deficient, and heavy fertilization and liming are required for the successful growth of crops such as red clover and alfalfa.

Jefferson stony fine sandy loam, hilly phase (Jk).—Formation of this well-drained soil of the colluvial lands has taken place at the base of mountain slopes from materials washed or rolled chiefly from Ramsey soils. It differs from the rolling phase chiefly in having steeper slopes of 15 to 30 percent. It is somewhat more variable in characteristics, especially stoniness and depth to underlying material. It occurs in small irregularly shaped areas in close association with Ramsey and Allen soils.

Profile description:

0 to 8 inches, yellowish-gray very friable stony fine sandy loam.
8 to 22 inches, grayish-yellow to brownish-yellow friable stony sandy clay loam or clay loam.
22 inches +, brownish-yellow stony sandy clay loam mottled with gray, yellow, red, and brown; depth of colluvial deposit ranges from 3 to 15 feet or more.

This soil is strongly acid and contains low supplies of organic matter and plant nutrients. It absorbs moisture readily but is too porous to retain it well. The soil is sufficiently permeable to plant roots, air, and moisture. Many rounded and angular stone fragments, 2 to 10 inches across, are on the surface and throughout the soil mass. A few stones more than 10 inches in diameter lie on the surface.

Use and management.—Practically all this hilly phase is forested. It is unsuitable for crops and poorly suited to pasture. Low fertility and water-holding capacity cause low productivity of crops and pasture. Stoniness and strong slopes make tillage, clipping of pasture, and control of weeds difficult; consequently, it is a good practice to grow a clean-cultivated crop at long intervals. Moderate to heavy applications of lime and phosphate are generally required to establish and maintain good pasture. On many farms the soil is best used for forest.

Jefferson stony fine sandy loam, eroded hilly phase (JF).—Moderate erosion is the chief factor differentiating this soil from the hilly phase. A considerable part of the original surface soil has been lost, and there has been some mixing of the remnants with the subsoil in the plow layer. The subsoil is exposed in a few places. The present surface soil is slightly heavier in texture, is lower in plant nutrients and organic matter, ranges from 4 to 10 inches thick, and is yellowish-gray to grayish-yellow friable stony fine sandy loam. The subsoil is grayish-yellow to brownish-yellow stony fine sandy clay loam. Slopes range from 15 to 30 percent. In distribution and association this phase is similar to the hilly phase.

A few small areas are included that differ in being relatively free of stone. Also included are a few severely eroded areas that have lost most of the surface soil and in places part of the subsoil.

Use and management.—All of this eroded hilly phase has been cleared. Much of it is in hay or pasture, a considerable part is idle, and some is in crops. Crops and pasture generally give very low yields.

This soil is generally considered unsuitable for crops requiring tillage and poorly suitable for pasture. Fair pasture can be established and maintained under a high level of management that includes moderate to heavy applications of lime and phosphate. On most farms pasture is probably the best use. Stones largely prevent clipping and make difficult the control of weeds in pastures.

Jefferson stony fine sandy loam, steep phase (JM).—This well-drained to excessively drained soil of the colluvial lands is at the base of steep or very steep mountain slopes. It has formed from materials rolled and washed from Ramsey soils of the uplands. It differs from the hilly phase chiefly in having stronger slopes (30- to 60-percent gradient), and also in having a shallower colluvial deposit, less distinct and thinner soil layers, and more large stones. It has a yellowish-gray stony fine sandy loam surface soil and a grayish-yellow to brownish-yellow stony sandy clay loam or heavy fine sandy loam subsoil. Closely associated are Ramsey, Allen, and other Jefferson soils.

Use and management.—Practically all this soil is in forest, its best use on most farms. A part is within the Cherokee National Forest. Steep slopes, low fertility, low water-holding capacity, and stoniness make this soil very poorly suited to crops or pasture.

Jefferson stony fine sandy loam, eroded steep phase (JH).—This well-drained soil of the colluvial lands has formed at the base of steep mountain slopes from materials washed or rolled from Ramsey and associated soils of the uplands. It differs from the hilly phase in being moderately eroded and having steeper slopes of 30 to 60 percent. In most places the colluvial deposit is shallower and the soil layers are less

distinct and thinner. Large stones, more than 10 inches across, are also more common. This soil is closely associated with Ramsey, Allen, and other Jefferson soils.

An estimated 25 to 60 percent of the original surface soil has been lost, and some areas are included that have lost practically all of this layer. The present surface layer is yellowish-gray to grayish-yellow stony fine sandy loam. The subsoil is grayish-yellow to brownish-yellow stony fine sandy loam to sandy clay loam.

Use and management.—Although all of Jefferson stony fine sandy loam, eroded steep phase, has been cleared and much of it cultivated, most of it is now in pasture or in idle land that is reverting to forest.

This soil is difficult to work and conserve, and productivity is low for most hay and pasture plants. It is low in fertility, low in water-holding capacity, stony to very stony, and very susceptible to further loss from erosion; consequently, it is generally not considered suitable for either crops or pasture. Forest is probably its best use, but on many farms it may be necessary to use it for pasture. Under a high level of management, including adequate applications of lime and phosphate, available evidence indicates that fair pasture can be established and maintained.

Jefferson gravelly loam, eroded undulating phase (JD).—This soil of the colluvial lands has formed from local alluvium at the base of upland slopes. The alluvial material, which extends out some distance over the adjacent valley floor, washed largely from Ramsey soils but in most places contains a small admixture of material from Teas and Litz soils. The soil is underlain by calcareous shale or limestone at 5 to 20 feet or more. Slopes range from 2 to 7 percent. Surface runoff is moderately slow, and internal drainage is moderate. Most of the soil is in the Jefferson-Masada-cobbly alluvium soil association, but some areas are in the Jefferson-Allen-Sequatchie association. Allen, Sequatchie, Masada, Ramsey, Teas, and Litz soils, and other members of the Jefferson series are closely associated.

Profile description:

0 to 10 inches, brownish-gray to yellowish-gray gravelly loam; in wooded areas upper 1 to 2 inches is grayish-brown gritty loam stained dark with organic matter.

10 to 18 inches, light yellowish-brown friable heavy loam.

18 to 36 inches, yellowish-brown to brownish-yellow moderately friable gravelly clay loam or sandy clay loam with a moderate medium blocky structure.

36 inches +, yellowish-brown or brownish-yellow friable sandy clay loam lightly streaked and splotched with gray, brown, and yellow.

The soil is medium to strongly acid and moderately well supplied with organic matter and plant nutrients. Many semiangular sandstone and quartzite fragments up to 8 inches across are on the surface and throughout the soil. In most places the fragments interfere with tillage. The soil is permeable to air, roots, and water. Rainfall is readily absorbed, and water-holding capacity is moderately high.

A part of the original surface soil has been eroded away. Some mixing of the remnants of the surface soil with the subsoil has occurred in the plow layer; consequently, the surface layer is now more variable in color and consistence than before erosion took place.

As mapped, this soil includes several minor variations. Boundaries between it and the associated soils are indistinct in places; consequently, small areas of associated soils are included. Some soils of silt loam and fine sandy loam textures are also included. A considerable part of the soil is uneroded.

Use and management.—Most of Jefferson gravelly loam, eroded undulating phase, is cleared and used for the common field crops. About 20 percent of the cultivated land is in corn, 15 percent in small grain, 30 percent in hay, 20 percent in pasture, and 5 percent in other crops (including tobacco); 10 percent is idle or in nonfarm uses. A wide variety of crops are grown, but not in systematic rotation. A few farmers follow a 3- or 4-year rotation of corn, small grain, and hay. Some crops receive light applications of fertilizer. Under common management practices, corn produces about 20 bushels an acre; wheat, 8 bushels; tobacco, 700 pounds; and red clover hay, 1.0 ton.

This soil is well suited to most of the common crops of the county and very well suited to tobacco. It is similar to Jefferson stony fine sandy loam, undulating phase, in use and management requirements. Its fertility and water-holding capacity are higher, however, and under the same level of management, higher crop yields can be expected. A moderately short rotation that includes a deep-rooted legume should be adequate. Fertilization and liming are important for most crops and essential for such crops as alfalfa and red clover. The soil is slightly susceptible to erosion, and contour tillage should be practiced where feasible.

Jefferson gravelly loam, rolling phase (JE).—This soil has formed at the base of upland slopes. The parent material, washed from the slopes, comes largely from Ramsey soils but includes a small admixture of material from Teas and Litz soils in most places. Slopes range from 7 to 15 percent. External and internal drainage are moderate. Allen, Ramsey, Sequatchie, Teas, Litz, and other Jefferson soils are closely associated with this phase.

Profile description:

0 to 10 inches, brownish-gray to yellowish-gray friable gravelly loam; in wooded areas upper 1 to 2 inches is grayish-brown gritty loam stained dark with organic matter.

10 to 18 inches, light yellowish-brown friable heavy loam.

18 to 32 inches, yellowish-brown to brownish-yellow moderately friable gravelly clay loam or sandy clay loam with a moderate medium blocky structure.

32 inches +, yellowish-brown or brownish-yellow friable sandy clay loam lightly streaked and splotched with gray, brown, and yellow.

The soil is strongly acid, moderately well supplied with organic matter and plant nutrients, and moderately high in water-holding capacity. Numerous sandstone and quartzite fragments up to 8 inches across are on the surface and throughout the profile in quantities sufficient to interfere with tillage. The soil is permeable to air, roots, and water.

Use and management.—About half of Jefferson gravelly loam, rolling phase, is in forest; the rest is cleared and used for crops or pasture. About 20 percent of the cleared land is in corn, 10 percent in small grains, 30 percent in hay crops, 20 percent in pasture, and

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10 percent in other crops; and 10 percent is idle. Present use and management practices are similar to those for Jefferson gravelly loam, eroded undulating phase. Under common management, corn produces 18 bushels an acre; wheat, 6 bushels; and tobacco, 700 pounds.

This soil is well suited to most of the common crops of the county, especially tobacco. Fertilization is required for increasing or maintaining crop yields, and lime and phosphate are essential for alfalfa and red clover. The supply of lime and most major plant nutrients is deficient. In most places the soil can be maintained in a rotation of moderate length that includes legume crops, preferably deep-rooted ones. Susceptibility to erosion is moderate, and contour tillage should be practiced where feasible. Terraces to aid in water control may be desirable on farms where crops must be grown at frequent intervals.

Jefferson gravelly loam, eroded rolling phase (Jc).—This phase differs from the rolling phase chiefly in being eroded. A considerable part of the original surface layer, including the thin surface layer of higher organic-matter content, has been lost. All the surface layer has been lost in small spots, and in these the subsoil is exposed. Some mixing of the original surface soil and the subsoil has occurred in places, but the present surface layer is not significantly heavier in texture. The soil is closely associated with Allen, Ramsey, Sequatchie, Teas, and other Jefferson soils.

Use and management.—Practically all of this eroded rolling phase has been cleared and cultivated. About 20 percent is in corn, 15 percent in small grain, 30 percent in hay crops, 20 percent in pasture, and 5 percent in other crops. Approximately 10 percent of the land is left idle. Many crops are grown in very irregular rotations. Tobacco and truck crops are commonly heavily fertilized, and on some farms other crops receive light applications. The use of lime and phosphate for hay and pasture crops has greatly increased recently. Under the prevailing management, corn yields 15 bushels an acre; wheat, 5 bushels; tobacco, 550 pounds; and red clover hay, 0.8 ton.

This soil is suited to crops, but it contains much gravel that materially interferes with tillage. Use and management requirements are similar to those for the rolling phase. As a result of erosion, supplies of organic matter and plant nutrients and the water-holding capacity are somewhat low, and susceptibility to further erosion is greater. Rotations should be somewhat longer than for the rolling phase, and heavier fertilization is required to maintain comparable yields. Contour tillage should be practiced where feasible, and terraces may be desirable on some slopes.

Jefferson gravelly loam, eroded hilly phase (JB).—Local alluvium washed from Ramsey and associated soils is the material from which this well-drained soil of the colluvial lands has formed. The soil differs from the eroded rolling phase chiefly in having steeper slopes (15 to 30 percent). Stoniness, distinctness and thickness of soil layers, and the depth of the colluvial deposit are also more variable. The surface soil, 4 to 10 inches deep, is brownish-gray to light yellowish-brown friable gravelly loam. The subsoil is yellowish-brown or brownish-yellow moderately friable clay loam or sandy clay loam. Some uneroded areas are included that have a surface layer more uniform in color and thickness and higher in organic-matter content. Teas, Litz, Ramsey, Allen, and other Jefferson soils are associated with this phase.

Use and management.—About one-third of this eroded hilly phase is still forested. Cleared areas have all been used for crops and pasture—an estimated 15 percent is used for corn, 10 percent for small grains, 25 percent for hay crops, 25 percent for pasture and 5 percent for other crops. About 20 percent of the cleared land is idle or in nonfarm uses. A wide variety of crops are grown, and, in general, a larger percentage of close-growing crops or pasture is grown than on the eroded rolling phase. Fertilization practices are about the same, but crop yields are lower. Under common management practices, corn yields 10 bushels an acre; wheat, 5 bushels; and red clover hay, 0.7 ton.

This soil is suited to cropping but exacting in management requirements. It is less desirable for crops than the eroded rolling phase, chiefly because its stronger slopes make tillage and control of runoff and erosion more difficult. If used for crops, proper and adequate fertilization and long rotations consisting of close-growing legumes and grasses are required to maintain or increase yields. On many farms it will probably be more feasible to use the soil for pasture than to practice the level of management necessary to maintain it in a crop rotation. Fair to good pasture can be established and maintained under management that includes adequate applications of lime and phosphate.

Leadvale silt loam (La).—Most of the local alluvium from which this colluvial soil has formed has washed from Dandridge soils. Narrow, elongated areas are on 5- to 15-percent gradient at the base of slopes, mainly in the Dandridge-Hamblen soil association. Dandridge soils are in the adjacent uplands in most places, and Hamblen soils are in the nearby bottom lands. Surface runoff is slow to moderate, and internal drainage is slow.

Profile description:

0 to 10 inches, yellowish-gray or brownish-gray friable silt loam.
10 to 24 inches, brownish-yellow to yellow moderately friable but firm silty clay loam with a weak medium blocky structure.
24 inches +, yellow moderately compact to friable silty clay loam mottled with gray, yellow, and brown; depth of the colluvial deposit ranges from about 2 to 10 feet.

This soil is medium to strongly acid, apparently low in content of organic matter, and moderately well supplied with plant nutrients. It is relatively free of stone, but numerous shale particles are on the surface and throughout the profile in most places. Soil moisture conditions are favorable for most crop plants except such deep-rooted legumes as alfalfa and sweetclover. During and following heavy rains the soil becomes saturated with water.

The soil varies somewhat from place to place in texture, drainage, and depth of colluvial material. It grades into Dandridge soils on one side and into Hamblen on the other. Some included areas have slopes with less than 5-percent gradient.

Use and management.—Most of Leadvale silt loam is cleared for crops. About 30 percent is in corn, 20 percent in small grains, 30 percent in hay and pasture, and 10 percent in other crops. The rest is idle or in nonfarm uses. Many crops are grown in relatively short irregular rotations. On many farms small grains and corn receive light applications of fertilizer; lime has been applied to a small acreage. Tobacco and truck crops receive moderate to heavy applications

of a complete fertilizer. Acre yields under prevailing management are 20 bushels of corn, 9 bushels of wheat, and 600 pounds of tobacco.

This soil is suited to crops and pasture. Under good management, including adequate fertilization, it can be maintained under a moderately short crop rotation. Most of the common field crops are fairly well suited; alfalfa possibly is an exception. Adequate applications of lime, phosphorus, nitrogen, and possibly potash are the chief requirements for maintaining high yields; however, some attention must be given to control of runoff on the more sloping parts.

Limestone rockland (L).—Soil material, predominantly Dunmore soil material, occupies less than 25 percent of the surface of this land type. Limestone outcrops and fragments are so abundant as to make the land nearly worthless as pasture. The land supports a very sparse scrubby forest. Outcrops protrude from 1 to 4 feet. Slopes range from 30 to 60 percent, but some narrow bluffs are included.

Lindside silt loam (LB).—This soil consists mainly of general alluvium washed from uplands underlain by limestone, but small quantities of material from other sources—chiefly Dunmore, Decatur, Fullerton, Groseclose, and Clarksville soils—are present in most places. The surface is nearly level, and all areas are subject to overflow. Internal and external drainage are slow. Areas are narrow, elongated, and occur along small streams. The soil is associated with Dunmore, Decatur, Fullerton, and Clarksville soils of the adjacent uplands and with Emory and Greendale soils of the colluvial lands.

Profile description:

0 to 16 inches, grayish-brown or light-brown mellow silt loam.
16 to 30 inches, mottled gray and light yellowish-brown heavy silt loam.
30 inches +, predominantly gray silt loam to silty clay loam splotched with brown and yellow; bedrock at 5 to 10 or more feet.

The soil is medium to slightly acid, well supplied with organic matter, and relatively free of stone. Although it is permeable to air, roots, and water, the lower layers are saturated with water part of the time, which restricts permeability. Water-holding capacity is high. A few small poorly drained areas and some better drained ones are included.

Use and management.—Practically all of Lindside silt loam has been cleared and cultivated. About 35 percent is in corn, 10 percent in small grains, 30 percent in hay, 20 percent in rotation pasture, and 5 percent in other crops. Crops are not systematically rotated, nor is fertilization a common practice. Under prevailing management practices, corn produces about 45 bushels an acre and lespedeza hay about 1.0 ton.

Although this soil is productive, its use suitability is limited by imperfect drainage and susceptibility to overflow. Corn and certain hay and pasture crops are well suited, but stands of alfalfa are difficult to maintain, and small grains commonly lodge because of the high water table. Excessive moisture interferes with tillage and other field operations; otherwise, the soil is not difficult to work. It is naturally well supplied with plant nutrients and organic matter, which are periodically replenished by deposition of sediment by floodwaters.

Masada silt loam, undulating phase (MF).—Most of the high stream terraces occupied by this soil are 30 to 100 feet above the present flood plain. The parent material from which this phase is formed has washed chiefly from uplands underlain by granite and gneiss but in most places includes some material from sandstone, quartzite, shale, and slate. The soil has 1- to 7-percent slopes. Surface runoff is slow to moderate, and internal drainage is moderate. Areas are principally in the Hiwassee-Masada-Altavista soil association, in close association with Hiawassee, Altavista, Roanoke, State, Congaree, Fullerton, Dunmore, and other Masada soils.

Profile description:

0 to 10 inches, grayish-brown mellow friable silt loam.
10 to 34 inches, yellowish-brown (reddish in places) friable sandy clay loam or silty clay loam with a moderately well developed medium blocky structure.
34 inches +, brownish-yellow or yellow moderately friable sandy clay loam or sandy clay faintly splotched with gray below about 40 inches; limestone or calcareous shale at depths of 6 to 20 feet in most places.

The soil is medium to strongly acid and apparently contains a moderate quantity of organic matter and plant nutrients. A few gravelstones and quartzite cobblestones are on the surface and throughout the soil in many places. The soil is permeable to air, roots, and water. Water-holding capacity is relatively high. Although a considerable part of it has been eroded away in places, the original surface soil still constitutes much of the plow layer in most areas.

Use and management.—About 200 acres of Masada silt loam, undulating phase, practically all of which has been cleared and cultivated, is within the city limits of Elizabethton and is consequently removed from agricultural use. Of the rest, about 5 percent is idle and 20 percent is in corn, 15 percent in small grain, 30 percent in hay, 20 percent in pasture, and 10 percent in other crops. A wide variety of crops are grown. Some farmers use a 3- or 4-year rotation of corn, small grain, and hay. Tobacco and truck crops are moderately heavily fertilized with a complete fertilizer. Corn and small grains may receive light applications of a low-analysis fertilizer, but many fields are not fertilized. Acre yields under prevailing management are 40 bushels of corn, 19 bushels of wheat, 1,400 pounds of tobacco, and 1.4 tons of red clover hay.

This soil is well suited to crops and pasture. It is moderately productive under present management but responds to better management practices. The supply of lime, phosphate, and nitrogen is deficient for high yields of most crops. Potash is apparently adequate for most crops, and the need for it depends largely on the crop and the past cropping system. Lime and phosphate are essential in most places for the successful growth of alfalfa or red clover. The soil is only slightly susceptible to erosion; special practices for water control should not be necessary, although it is advisable to practice contour tillage if at all feasible.

Masada silt loam, eroded rolling phase (ME).—This well-drained soil of the old stream terraces has developed from old alluvium that washed principally from Ashe, Porters, and associated soils of the uplands. The chief characteristics differentiating this soil from the

undulating phase are greater erosion and steeper slope (7 to 15 percent). About one-half to two-thirds of the original surface soil has been lost as a result of erosion; consequently, the present surface layer is slightly heavier, but not so much so that workability is significantly affected. The subsoil is exposed in some severely eroded spots.

This soil is largely confined to the Hiwassee-Masada-Altavista soil association. It is closely associated with Hiwassee, Altavista, Roanoke, State, Congaree, and other Masada soils.

Use and management.—All of this eroded rolling phase has been cleared and used for crops and pasture. About 20 percent is used for corn, 15 percent for small grain, 30 percent for hay, 20 percent for pasture, and 5 percent for other crops. The rest of the land is idle. In general, crops are not systematically rotated. A few farmers, however, follow a 4-year rotation of corn, small grain, hay, and pasture. Tobacco and truck crops are heavily fertilized, but other crops are not consistently fertilized. Under common management practices, corn produces 35 bushels an acre; wheat, 14 bushels; and red clover hay, 1.2 tons.

This soil is well suited to most of the common field crops and pasture plants of the county, but is less desirable for crops than the undulating phase. Use and management requirements are somewhat similar to those for the undulating phase; but this soil is lower in organic matter and plant nutrients, because they have been removed by cropping and erosion. Water-holding capacity is also slightly lower, and susceptibility to erosion is greater. If crop yields are to be maintained at levels comparable to those of the undulating phase, a longer rotation, including more legumes and grasses, and possibly somewhat heavier applications of lime and phosphate will be required. Surface runoff is more rapid, and erosion control is more difficult. Contour tillage should be practiced. Terraces may be desirable on some slopes, especially if row crops are grown frequently.

Masada gravelly silt loam, undulating phase (MD).—This soil of the high stream terraces has formed from old alluvium washed chiefly from Ashe, Porters, and associated soils. It differs from Masada silt loam, undulating phase, chiefly in containing sufficient gravel in the surface layer to interfere with tillage. Like that soil, it has 1- to 7-percent slopes. Hiwassee, Altavista, Roanoke, State, Congaree, Fullerton, and Dunmore soils are closely associated with this soil. Surface runoff is slow to moderate, and internal drainage is moderate.

Profile description:

0 to 8 inches, grayish-brown friable gravelly silt loam.
8 to 32 inches, yellowish-brown (reddish in many places) friable gravelly silty clay loam to sandy clay loam.
32 inches +, brownish-yellow or yellow, splotched with gray in many places, moderately friable sandy clay loam or sandy clay.

The soil is medium to strongly acid, contains a moderate quantity of organic matter, and is very permeable to air, water, and roots. It is characteristically gravelly or cobbly on the surface and throughout the profile. Rainfall is readily absorbed, and water-holding capacity is moderate.

Some areas are moderately eroded; a considerable part of the original surface soil is missing, and in some spots the subsoil is exposed. Some areas have larger and more numerous cobbles than is characteristic.

Use and management.—Masada gravelly silt loam, undulating phase, has practically all been cleared and used for crops or pasture. It is used and managed in about the same way as Masada silt loam, undulating phase, but expected crop yields are somewhat lower. Under the prevailing management, corn produces 30 bushels an acre; wheat, 12 bushels; and red clover hay, 1.0 ton.

The soil is suited to crops and pasture, although gravel and cobblestones in the plow layer materially interfere with tillage. It is moderately productive, and responsive to good management. On most farms an improved management program would include greater use of deep-rooted legumes and grasses, larger applications of lime and phosphate for hay crops and pasture, and heavier applications of high-analysis fertilizer for other crops. The soil is only slightly susceptible to erosion.

Masada gravelly silt loam, eroded rolling phase (MB).—This well-drained soil is on old high stream terraces. Its alluvium has washed from Ashe, Porters, and associated soils of the mountains. It differs from the undulating phase chiefly in being eroded and in having steeper slopes (7 to 15 percent). Most areas are in the Hiwassee-Masada-Altavista soil association.

A considerable part of the original surface soil has been lost from most areas, and in some small spots the subsoil is exposed. Some of the remnants of the original surface soil have mixed with the subsoil in the plow layer. The present surface layer is friable gravelly silt loam, highly variable in thickness (4 to 8 inches) and color (grayish-brown to yellowish-brown). The subsoil is yellowish-brown friable gravelly silty clay loam or sandy clay loam.

Use and management.—Most of this eroded rolling phase has been cleared. About 20 percent is used for corn, 20 percent for small grain, 30 percent for hay, 15 percent for pasture, and 5 percent for other crops. The rest of the land is idle. Crops are not commonly rotated. Fertilization is a common practice only for tobacco and truck crops. Under the prevailing management, corn produces 25 bushels an acre; wheat, 9 bushels; and red clover hay, 1.1 tons.

This soil is suited to most crops of the area, but fertilization, especially with lime and phosphate, is required for the successful growth of crops as red clover and alfalfa. The soil is only moderately productive of most crops but it responds to good management. It is slightly to moderately deficient in lime, phosphate, and nitrogen, but the supplies of available potash are adequate for most crops. The soil is moderately susceptible to erosion, but if crop rotations of moderate length are used, adequate fertilizer is applied, and contour tillage is practiced, there should be no serious loss of soil material.

Masada gravelly silt loam, eroded hilly phase (MA).—The alluvium from which this well-drained soil has formed has washed chiefly from Ashe, Porters, and associated soils of the mountains. The soil differs from the eroded rolling phase chiefly in having stronger slopes (15 to 30 percent). It is also somewhat more variable in stoniness, depth of alluvial deposit, and in distinctness and thickness of the soil layers. Most areas are on old high stream terraces, associated with Hiwassee, Altavista, State, Congaree, Teas, Fullerton, Dunmore, and other Masada soils.

The surface soil, a grayish-brown to yellowish-brown friable gravelly silt loam, is 4 to 8 inches thick. In a few places, however, all this layer is missing. The subsoil is yellowish-brown friable gravelly silty clay loam to sandy clay loam.

Use and management.—Practically all of Masada gravelly silt loam, eroded hilly phase, has been cleared and cultivated. Most of it is moderately eroded, a small part is severely eroded, and about 5 percent has a forest cover and is uneroded. A major part is in hay crops and pasture, some is in crops, and a considerable part is idle or is reverting to forest. Crop and pasture yields are low.

This soil is poorly suited to intertilled crops and on most farms is probably best used for semipermanent hay crops or pasture. Pasture gives low yields if amendments are not applied. Good pasture can be established and maintained by applying adequate quantities of lime and phosphate and by controlling grazing. Strong slopes and stoniness not only interfere with tillage of crops but also with clipping of pasture. Weeds are therefore difficult to control on permanent pasture. Farmers consider the growing of corn or other clean-cultivated crops every 7 to 10 years a good practice.

Masada gravelly silt loam, eroded steep phase (Mc).—This soil of the high stream terraces has formed from materials washed from Ashe, Porters, and associated soils. It is similar to the eroded hilly phase in degree of erosion, but it differs in having a steeper slope (30 to 60 percent). Although most areas are moderately eroded, some are uneroded and others are severely eroded. Most of this soil is in the Hiwassee-Masada-Altavista soil association.

The present surface soil, a grayish-brown to yellowish-brown friable gravelly silt loam, is 4 to 8 inches thick in most places. The subsoil is yellowish-brown friable gravelly silty clay loam to sandy clay loam. Depth to underlying material is generally less than for the eroded hilly phase; surface soil and subsoil layers are less distinct and more variable in thickness; and stoniness is more variable. Gravel and cobblestones on the surface and in the plow layer of this soil interfere with or, in some places, almost prohibit tillage.

Use and management.—About 80 percent of this gravelly soil has been cleared and used for crops and pasture. Much of the cleared land has been abandoned and is now reverting to forest. The major part of the cleared land is used for pasture, and a small part for crops. Pasture and crop yields are generally very low.

Steepness, stoniness, and susceptibility to erosion make this soil not suitable for crops and very poor for pasture. On most farms, forest is its best use. For a discussion of reforestation and forest management, see the section on Forests.

Matney loam, rolling phase (Mg).—Areas of this soil lie on mountain crests or plateaus and are largely derived from residuum of quartzite, conglomerate, or slate. Practically all of the soil is in the Ramsey-Jefferson-Matney association, commonly on the mountain slopes above steep stony Ramsey soils. Slopes range from 7 to 15 percent, but some small included areas have 2- to 7-percent slopes. Surface runoff is slow to moderate, and internal drainage is moderate.

Profile description:

0 to 8 inches, very friable brownish-gray or yellowish-gray loam; in wooded areas the surface inch is dark-gray loose loam or fine sandy loam.

8 to 30 inches, brownish-yellow friable clay loam with a weak medium blocky structure.
30 inches +, yellow friable clay loam or sandy clay loam faintly splotched with gray; in most places bedrock is at 3 to 5 feet.

The soil is medium to strongly acid and low in supplies of plant nutrients and organic matter. A few small quartzite fragments are on the surface and throughout the profile in most places, but these do not interfere materially with tillage. The soil is very permeable to air, roots, and water, but water-holding capacity is only moderate.

A variation, largely confined to Cross Mountain, is included that is heavier and darker throughout the profile than the soil described. This variation is characterized by a grayish-brown friable loam surface soil and a brown friable silty clay loam subsoil. Some included areas also differ in being moderately eroded.

Use and management.—Most of Matney loam, rolling phase, is in forest, but a part has been cleared and used, chiefly for vegetables and pasture. Although many areas are physically suited to crops or pasture, they are so isolated by large tracts of steep stony Ramsey soils that it is not feasible to use them.

This soil is suited to most of the common crops and pasture but gives low yields. It is moderately deficient in lime, phosphate, potash, and nitrogen for most crops, but is highly responsive under management that includes application of these plant nutrients. Nonetheless, higher yields are more difficult to maintain than on the heavier soils of the limestone valleys. Adequate applications of lime and phosphate are essential for success with many crops, such as the deep-rooted legumes. Crops are rarely damaged by droughts, for distribution of rainfall is favorable at this relatively high altitude.

Nolichucky fine sandy loam, eroded rolling phase (NB).—High stream terraces, most of them 75 to 150 feet above the present flood plain, are occupied by this soil. The parent material is old alluvium washed largely from uplands underlain by sandstone, quartzite, and shale. A small admixture of material from other rocks is included. Most of the terrace deposits are underlain by limestone at depths of 3 to 15 feet or more. Slopes range from 5 to 15 percent, but some small included areas have 2- to 5-percent slopes. Both external and internal drainage are moderate. Most of this soil is in the western part of the county, where it is closely associated with Holston, Fullerton, Jefferson, Allen, and Sequatchie soils.

Profile description:

0 to 8 inches, yellowish-gray to brownish-yellow very friable fine sandy loam.
8 to 18 inches, brownish-yellow or yellowish-brown friable sandy clay loam or heavy fine sandy loam.
18 to 48 inches, reddish-yellow or yellowish-red moderately friable clay loam to sandy clay loam having a moderate medium blocky structure.
48 inches +, yellowish-red firm sandy clay loam to sandy clay streaked and splotched with gray; beds of coarse gravel and cobblestones at depths of 3 to 15 feet in most places.

The soil is strongly acid, moderately low in organic matter and plant nutrients, and moderate in water-holding capacity. A few gravelstones and cobblestones are on the surface and throughout the profile. The soil is permeable to roots, air, and moisture.

Most areas are moderately eroded; 25 to 60 percent of the original surface soil has been lost. Some mixing of remnants of the original surface soil with the subsoil has taken place in the plow layer. As a

result the present surface layer is highly variable in color, texture, and thickness. In some places all the original surface layer is missing and the subsoil is exposed. A few uneroded areas are included with this soil.

Use and management.—All but a few acres of Nolichucky fine sandy loam, eroded rolling phase, have been cleared and cultivated. About 25 percent is in corn, 15 percent in small grain, 30 percent in hay, 20 percent in pasture, and 5 percent in other crops. Approximately 5 percent of the land is idle. Many kinds of crops are grown, but only a few farmers follow systematic crop rotations. Tobacco and truck crops receive heavy applications of complete fertilizer; other crops receive only light ones. The use of lime and phosphate on hay crops and pasture has been increasing rapidly in recent years. Under prevailing management, acre yields are 28 bushels of corn, 9 bushels of wheat, and 1.1 tons of red clover hay.

The soil is well suited to crops and pasture. It is deficient in lime and most of the major fertilizing elements, but it responds well to their application. The immediate response to fertilization is likely to be greater than on Dunmore soils, for example, but the response is unlikely to be so lasting. Adequate applications of lime and phosphate are essential for alfalfa and red clover. In most places the soil is moderately susceptible to erosion, and cultivation needs to be on the contour. Under ordinary conditions a rotation of at least moderate length is needed. Terracing the land, if feasible, may make it possible to shorten the rotation.

Nolichucky fine sandy loam, eroded hilly phase (NA).—This well-drained soil is located on high stream terraces that are 75 to 150 feet above the present flood plain. It has formed from old alluvium washed from uplands underlain largely by quartzite, sandstone, and shale. It differs from the eroded rolling phase chiefly in having steeper slopes (15 to 30 percent). Most of the soil is in the western part of the county in association with Holston, Fullerton, Jefferson, Allen, and Sequatchie soils.

The surface soil, which consists of yellowish-gray to brownish-yellow fine sandy loam, is 4 to 8 inches thick. The subsoil consists of reddish-yellow or yellowish-red moderately friable clay loam or sandy clay loam.

Use and management.—Practically all of Nolichucky fine sandy loam, eroded hilly phase, has been cleared and used for crops and pasture. Most of it is now in hay crops and pasture, some is in tilled crops, and a considerable part is idle. Both crop and pasture yields are moderately low.

This soil is not well suited to crops that require tillage, but presumably it can be maintained under a high level of management for such use. Crop rotations need to be long and consist largely of close-growing legumes and grasses. Fertilization is necessary for most crops and essential for some, as the soil is low in organic matter, lime, phosphate, and potash. Susceptibility to erosion is fairly high, and cultivation should be on the contour.

This soil is better suited to pasture or semipermanent hay crops than to cultivated crops. On most farms, pasture is probably its best use. Good pasture can be established and maintained under management that includes the use of lime and phosphate and carefully controlled grazing.

Ooltewah silt loam (Oa).—This alluvial soil is located in depressions or sinks in the Great Valley part of the county that is underlain by limestone. It has formed from local wash from adjacent upland slopes. External drainage is very slow or ponded, and internal drainage is slow. The soil is closely associated with and derived from material washed from Decatur, Dunmore, Fullerton, Groseclose, and Clarksville soils. Most areas are surrounded by Fullerton soils.

Profile description:

0 to 15 inches, grayish-brown or light-brown friable silt loam.
15 to 25 inches, yellowish-brown to brownish-gray friable heavy silt loam or silty clay loam splotched with gray and yellow.
25 inches +, highly mottled moderately friable silty clay loam; depth to bedrock ranges from about 3 to 10 feet or more.

The soil is medium to slightly acid, high in content of organic matter, and relatively well supplied with plant nutrients. It is permeable, but the frequently saturated subsoil restricts root penetration and air circulation. As the soil is in depressions with no surface outlets, it is subject to flooding after heavy rains.

Use and management.—Ooltewah silt loam is cleared and used for crops and pasture. As areas are small, many of them are not given individual attention but are treated in much the same way as surrounding areas of more extensive soils. Where they are given individual attention, they are used chiefly for corn, hay, and pasture. Ordinarily they are inadequately drained for the successful production of alfalfa, small grains, and tobacco, but corn and most of the hay crops are grown successfully. Drainage would broaden use suitability and productivity for most crops, but it is impractical in most places because outlets are lacking. Some success has been reported from the exploding of dynamite at various depths in the substratum.

Perkinsville loam, rolling phase (Pd).—This soil is derived chiefly from residuum of light-colored granite. The gradient ranges from 7 to 15 percent. Areas are on the mountain crests of plateaus above steep Ashe soils and are widely distributed in the Ashe-Tusquitee-Perkinsville soil association. Surface runoff is slow to moderate, and internal drainage is moderate.

Profile description:

0 to 8 inches, brownish-gray very friable loam; in wooded areas the 2-inch surface layer is dark grayish brown and high in organic matter.
8 to 28 inches, brownish-yellow to yellow friable clay loam or silty clay loam with a weak medium blocky structure.
28 inches +, yellow or grayish-yellow clay loam mixed with partly disintegrated rock; bedrock at 3 to 6 feet in most places.

The soil is strongly acid, low in organic matter, moderately low in plant nutrients in most places, and usually free of stone. It is very permeable to air, roots, and water. Rainfall is readily absorbed and moderately well retained.

As mapped, the rolling phase includes a few small areas that have sandy loam surface soil and small areas that are stony. Some areas also differ in having a reddish subsoil.

Use and management.—Most of Perkinsville loam, rolling phase, still is forested, but a small part has been cleared and used for crops and pasture. It is used chiefly for subsistence crops. Yields of crops and pasture are generally low.

The soil is moderately well suited to crops and pasture, but many areas are isolated by large areas of steep stony Ashe soils. The sup-

ply of lime, phosphate, and nitrogen is deficient for most crops, but potash is apparently adequate for all except the most exacting ones. The soil responds to good management that includes adequate fertilization, but the response is not so lasting as on the heavy soils of the limestone valleys. The quantity and distribution of rainfall are adequate for high yields of all crops, although water-holding capacity is only moderate. Owing to favorable moisture conditions and cool climate, good to very good pasture can be maintained throughout the summer on adequately limed and phosphated fields.

Perkinsville loam, eroded rolling phase (Pb).—Mountain crests, largely above 3,500 feet, that are underlain by granite are occupied by this well-drained soil. Slopes range from 7 to 15 percent. The soil is in the Perkinsville-Balfour-Matney and Ashe-Tusquitee-Perkinsville soil associations. It differs from the rolling phase chiefly in being moderately eroded. A considerable part of the original surface soil has been lost, and in places the subsoil is exposed. The present surface layer is 4 to 8 inches thick and consists of brownish-gray to brownish-yellow friable loam. The subsoil is brownish-yellow to yellow friable clay loam to silty clay loam.

This soil includes several variations. Most areas are free of stone, but some of those included contain stones in numbers sufficient to interfere with cultivation. Some small areas have a fine sandy loam texture; others differ in being heavier and having a reddish subsoil.

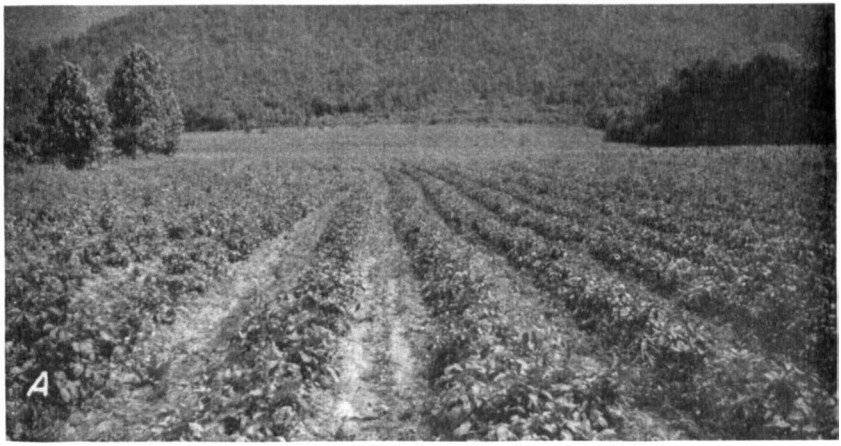
Use and management.—Most of Perkinsville loam, eroded rolling phase, is cleared and has been used for crops and pasture. An estimated 15 percent of the cleared area is in corn, 10 percent in small grain (including buckwheat), 30 percent in hay crops, 20 percent in pasture, and 15 percent in vegetables (pl. 5, *A*). About 10 percent of the cleared land is idle. Regular crop rotations are not common. Truck crops are usually heavily fertilized, but other crops are not commonly fertilized. Under prevailing management practices, corn produces about 20 bushels an acre; wheat, 10 bushels; and cabbage, 7 tons.

This soil is moderately well suited to the common crops and pasture. Owing to favorable moisture conditions and cool summer temperatures, it is apparently well suited to vegetable crops and pasture if adequately fertilized. The soil is deficient in lime, phosphate, and nitrogen for most crops. It is moderately susceptible to erosion and should be cultivated on the contour. A rotation of moderate length is needed.

Perkinsville loam, hilly phase (Pc).—This well-drained soil of the mountain uplands has developed from the residuum of granite. It differs from the rolling phase chiefly in having steeper slopes—15 to 30 percent. It is also more variable in depth to bedrock, stoniness, and distinctness of surface soil and subsoil layers. The surface soil is brownish-gray very friable loam; the subsoil, brownish-yellow to yellow friable clay loam or silty clay loam. In most places bedrock is at 3 to 5 feet, but it crops out in places. The soil is associated with Ashe, Porters, and other Perkinsville soils in the Ashe-Tusquitee-Perkinsville soil association.

Use and management.—Although this hilly phase is now in forest, accessible areas are moderately well suited to pasture. Low yields

A, Snap beans on Perkinsville loam, eroded rolling phase.
B, Good orchard grass and lespedeza pasture on Sequatchie gravelly loam that has been treated with 2 tons of burned lime and 200 pounds of 43-percent phosphate fertilizer an acre.



A, Irish potatoes on State loam; wooded Ramsey soils in background and Jefferson soils on foot slopes.
B, Pasture on Stony rolling land (Dunmore soil material).
C, Excellent permanent pasture of bluegrass and white clover on Tusquitee loam, undulating phase, that has received 2 tons of lime and 300 pounds of 43-percent phosphate fertilizer an acre.

of low quality pasture may be expected without amendments, but the soil is responsive to applications of lime and phosphate. Owing to favorable distribution of rainfall and cool summer temperatures, very good pasture can be maintained throughout summer if it is properly fertilized.

The soil is moderately well suited to crop production, provided a long rotation consisting chiefly of close-growing crops, including grasses and legumes, is used. Content of lime, phosphate and nitrogen is low in most areas, but potash is adequate for most crops. The soil is moderately to highly susceptible to erosion, and all tillage should be on the contour.

Perkinsville loam, eroded hilly phase (PA).—This well-drained soil of the mountain uplands has developed chiefly from residuum of granite. It differs from the rolling phase chiefly in being eroded and in having steeper slopes (15 to 30 percent). It is associated with Ashe, Porters, and other Perkinsville soils in the Ashe-Tusquitee-Perkinsville soil association.

About 25 to 75 percent of the original surface soil has been lost as a result of accelerated erosion. The subsoil may be exposed in small severely eroded spots. In some areas most of the original surface soil and a part of the subsoil may be missing. The present surface layer ranges from 4 to 8 inches thick and consists of brownish-gray to brownish-yellow friable loam. The subsoil is brownish-yellow to yellow friable clay loam or silty clay loam. Bedrock is at depths of 3 to 5 feet in most places, but bedrock outcrops are common.

Use and management.—All of Perkinsville loam, eroded hilly phase, has been cleared, and much of it has been cultivated. About 25 percent is used for crops such as corn, small grains, buckwheat, tobacco, and truck crops; 50 percent for hay crops and pasture; and 25 percent is idle, a part of which is reverting to forest. Fertilizer is not commonly used, except in light applications on grain crops and in moderately heavy applications on tobacco and truck crops.

This soil is similar in use and management to the hilly phase, but it is somewhat less desirable for either crops or pasture, chiefly because it has been damaged by erosion. The loss of the original surface soil material has resulted in a loss of organic matter and plant nutrients, a lowering of water-holding capacity, an increase in susceptibility to erosion, and a decrease in productivity for most crops. A part of this soil, however, particularly that on the milder slopes, is moderately well suited to crops grown in a long rotation. Close-growing crops (small grains, grasses, and legumes) need to be favored. The soil on many farms, especially on the steeper areas, is probably best used for permanent pasture.

Porters stony loam, steep phase (PK).—This soil occurs on steep mountain slopes, knobs, and ridges. It has developed from residuum of granite and gneiss on 30- to 60-percent slopes. It is closely associated with Burton, Ashe, Balfour, Tusquitee, and other Porters soils. In most places it is on steep mountain slopes below Balfour soils, which are on the mountain crests. Most of the acreage is in the Porters-Tusquitee-Balfour soil association. Surface runoff is very rapid, and internal drainage is rapid.

Profile description:

0 to 7 inches, brown to grayish-brown very friable stony loam; in wooded areas the 2-inch surface layer is brown or dark grayish-brown loose loam.

7 to 28 inches, brown to yellowish-brown friable stony loam to light clay loam.

28 inches +, yellowish-brown or brownish-yellow loam or clay loam containing a variable quantity of gray, partly disintegrated soft rock fragments; bedrock at 30 to 60 inches in most places.

The soil is medium to strongly acid throughout, relatively high in content of organic matter, and moderately high in supply of plant nutrients. Water-holding capacity is moderately low. Numerous stone —usually 2 to 10 inches in size but a few as large as boulders—are on the surface and throughout the profile. Enough stone fragments are on the surface or imbedded in the soil to interfere with tillage, but not enough to prohibit tillage that is otherwise feasible. An occasional bedrock outcrop is common, and mica flakes occur throughout the profile.

Small areas of associated soils are included with this one. Some areas, especially those above 3,500 feet in elevation, differ in having a darker surface soil that is higher in organic matter. The subsoil in some areas is reddish.

Use and management.—All of Porters stony loam, steep phase, is now in forest, and owing to stoniness and steep relief, that is considered the best use. On some farms the soil must be used for pasture. If properly managed, good pasture can be maintained on the less steep parts. Lime and phosphate are needed but are difficult to apply.

Porters stony loam, eroded steep phase (PG).—This excessively drained soil on steep mountain slopes has formed from residuum of granite and gneiss. It differs from the steep phase chiefly in being moderately eroded. Like that soil, it has 30- to 60-percent slopes. Most areas are in the Porters-Tusquitee-Balfour soil association.

From 25 to 75 percent of the original surface soil, including the thin surface layer of higher organic-matter content, has been lost. Some small areas are included that have lost most of the surface soil and, in places, a part of the subsoil. The present surface layer, 3 to 7 inches thick, consists of grayish-brown to yellowish-brown friable stony loam. The subsoil is brown to yellowish-brown friable stony loam or clay loam.

Use and management.—Porters stony loam, eroded steep phase, has been cleared and used for crops and pasture. Much of it is now in pasture, a small part is in crops, and a much larger part is idle or reverting to forest. Crop yields are commonly low, but pasture yields, even without amendments, are fair.

Use and management requirements are similar to those for the steep phase. This soil, however, is somewhat lower in content of organic matter and plant nutrients, has a lower water-holding capacity, and is more susceptible to further erosion. Owing to steepness and stoniness, forest is considered its best use, but the less steep parts of accessible areas are fairly well suited to pasture. A good response may be expected from pasture if lime and phosphate are used, but these amendments are difficult to apply.

Porters stony loam, very steep phase (PL).—Most features of this soil resemble those of the steep phase, but relief is steeper (above

60 percent in gradient), depth and stoniness are somewhat more variable, and bedrock outcrops and boulders are more common. This soil is on very steep to precipitous mountain slopes and associated with Balfour, Ashe, and other Porters soils. It is mostly in the Porters-Tusquitee-Balfour soil association. In a few places the soil contains fewer stones than is typical, and some areas have reddish subsoil.

Use and management.—Most of Porters stony loam, very steep phase, is still forested. The few cleared areas are principally in pasture or are idle. This soil is best suited to forest because of its very steep relief, stoniness, very rapid runoff, and high susceptibility to erosion if cleared. For a discussion of reforestation and forest management, see the section on Forests.

Porters stony loam, hilly phase (PH).—This excessively drained soil of the mountain uplands differs from the steep phase chiefly in having milder slopes (15 to 30 percent). In general, it is deeper, less stony, and has fewer bedrock outcrops. This soil is closely associated with Balfour, Ashe, and other Porters soils, chiefly in the Porter-Tusquitee-Balfour soil association.

Like the steep phase, this soil contains enough stones in the plow layer to interfere with but not prohibit cultivation. Stones vary in size from about 2 to 10 inches or more across. The surface soil is brown to grayish brown very friable stony loam, and the subsoil is brown to yellowish-brown friable stony loam to clay loam.

Use and management.—Forest covers practically all of Porters stony loam, hilly phase. Although the soil is suitable for pasture, such use is not feasible because most areas are isolated by large tracts of steep and stony Porters soils that are unsuitable. Fair pasture is obtained without using amendments, but good response may be expected from application of lime and phosphate. The soil is successfully used for crops on some farms, but tillage and harvesting require much hand labor.

Porters stony loam, eroded hilly phase (PF).—This excessively drained soil of the mountain uplands has formed from residuum of granite and gneiss. It differs from the steep phase in being moderately eroded and in having milder slopes (15 to 30 percent). Two- to ten-inch stones are sufficiently numerous on the surface to interfere materially with tillage. The soil is closely associated with Balfour, Ashe, and other Porters soils, chiefly in the Porters-Tusquitee-Balfour soil association.

Accelerated erosion has removed enough of the original surface layer to bring the original subsoil within ordinary plow depth in over half the area. The original surface soil remaining ranges from 3 to 7 inches deep in most places, but the subsoil is exposed in some small spots. The present surface layer is grayish-brown to yellowish-brown very friable stony loam, and the subsoil is brown to yellowish-brown stony loam to clay loam.

Use and management.—All of Porters stony loam, eroded hilly phase, has been cleared and used for crops or pasture. Most of it is now in pasture or hay crops, a small acreage is in crops, and a part is idle. Crop yields are generally low, but pasture yields are fair.

Owing to difficulty of working and susceptibility to erosion, this soil is generally considered better suited to pasture than to crops that require tillage. Fair pasture is obtained without the use of amendments,

but a good response can be expected if lime and phosphate are applied. If the soil is used for crops, a long rotation consisting chiefly of close-growing crops is needed. The supply of lime, phosphate, and nitrogen is deficient for most crops, but the potash content is adequate for high yields. The soil is susceptible to erosion, and tillage should be on the contour if at all feasible.

Porters loam, eroded steep phase (PE).—Areas of this soil occur on steep mountain slopes, knobs, and ridges on 30- to 60-percent slopes. The soil has formed from residuum of granite and gneiss. It differs from Porters stony loam, steep phase, chiefly in being less stony and in being moderately eroded. Ashe, Balfour, Tusquitee, Tate, and other Porters soils are closely associated, chiefly in the Porters-Tusquitee-Balfour soil association. Surface runoff is very rapid, and internal drainage is rapid.

Profile description:

0 to 6 inches, grayish-brown to yellowish-brown very friable loam.
6 to 30 inches, brown to yellowish-brown friable loam to clay loam.
30 inches +, yellowish-brown or brownish-yellow loam or clay loam containing a variable quantity of gray, partly disintegrated soft rock fragments; bedrock at 30 to 60 inches in most places.

The soil is medium to strongly acid, moderate in organic-matter content, moderately good in content of plant nutrients, and very permeable to air, roots, and water. In general, the soil is relatively free of stone, but a few areas may be stony. Mica flakes are common throughout the profile. Water-holding capacity is moderately low.

Most areas of this soil are moderately eroded; about 25 to 50 percent of the original surface soil has been lost by accelerated erosion. Some small included areas have lost most of the original surface soil, and in places, a part of the subsoil; other included areas are uneroded. In wooded areas the 2-inch surface layer is dark grayish-brown loose loam stained dark with organic matter.

Use and management.—About 8 to 12 percent of Porters loam, eroded steep phase, still has a forest cover; the rest has been cleared and is used for hay crops, some tilled crops, and pasture. A small part is idle. Amendments are not commonly used, nor are crops systematically rotated. Yields of crops are generally low, but those of pasture are fairly good.

Steep slopes make this soil unsuitable for crops under most conditions. It is well suited to permanent pasture if properly managed. Good pasture management includes adequate applications of lime and phosphate and careful control of grazing so as to maintain a good sod.

Quartzite and granite rockland (Q).—Areas in which granite or quartzite outcrops and fragments are so abundant as to make the soil nearly worthless for pasture compose this land type. Soil material, which is like that of Ramsey, Ashe, or Porters soils, occupies less than 25 percent of the surface. Outcrops protrude 1 to 4 feet. Slopes range from about 25 to 60 percent. This land type is not suitable for crops or pasture and is very poorly suited to forest.

Ramsey stony fine sandy loam, steep phase (RB).—Slopes of this soil are 30 to 60 percent in gradient. The soil somewhat resembles the Ashe soils in color and profile characteristics but differs in parent

material, having developed from residuum of quartzite, sandstone, conglomerate, slate, and shale. Areas are confined chiefly to the Ramsey-Jefferson-Matney soil association and are associated with Ashe, Perkinsville, Jefferson, Allen, Teas, Litz, and other Ramsey soils. Surface runoff is very rapid, and internal drainage is rapid.

Profile description:

0 to 8 inches, pale-brown to light yellowish-brown loose stony fine sandy loam; in wooded areas the surface inch is dark-gray loose fine sandy loam stained with organic matter.

8 to 24 inches, brownish-yellow to pale-yellow friable stony fine sandy loam or sandy clay loam.

24 inches +, pale-yellow sandy clay loam and thin layers of soft partly disintegrated rock fragments; in most places bedrock is at depths between 18 and 36 inches.

The soil is medium to strongly acid, low in content of organic matter, and moderately low in plant nutrients. Sandstone and quartzite fragments, 2 to 10 inches across, are on the surface and throughout the profile. The soil is very permeable to air, roots, and water. Water-holding capacity is low.

As mapped, this soil includes small areas of associated soils as well as a few small areas that differ in being moderately eroded.

Use and management.—Nearly all of Ramsey stony fine sandy loam, steep phase, is still in forest; a large percentage is within the Cherokee National Forest. Steepness, stoniness, shallow depth, and low fertility make forest the best use for this soil. For a discussion of forest management, see the section on Forests.

Ramsey stony fine sandy loam, very steep phase (Rc).—This excessively drained stony soil on steep mountain slopes has formed from residuum of quartzite, sandstone, slate, or shale. It differs from the steep phase chiefly in having slopes of about 60 percent. In general it has a shallower depth to bedrock, more stones, and a greater number of bedrock outcrops. The surface soil is pale-brown to light yellowish-brown loose stony fine sandy loam; the subsoil, brownish-yellow to pale-yellow friable heavy fine sandy loam. Areas are widely distributed throughout the Ramsey-Jefferson-Matney soil association, chiefly around the heads of drains.

Use and management.—All of this very steep phase is still forested, a large part being within the Cherokee National Forest. Very steep slopes, shallow depth, stoniness, and low fertility make this soil unsuitable for either crops or pasture. It is not very productive of forest, but is best used for that purpose.

Ramsey stony fine sandy loam, hilly phase (Ra).—This excessively drained soil of the mountain uplands has formed from residuum of quartzite, sandstone, slate, and shale. It differs from the steep phase chiefly in having milder slopes (15 to 30 percent). In general, it is also somewhat deeper, slightly less stony, and has fewer bedrock outcrops. Areas are widely distributed in the Ramsey-Jefferson-Matney soil association in close association with Perkinsville, Allen, Jefferson, Teas, Litz, and other Ramsey soils.

The surface soil is pale-brown to light yellowish-brown loose stony fine sandy loam, and the subsoil is brownish-yellow to pale-yellow very friable stony fine sandy loam or sandy clay loam. Bedrock is at 2

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to 5 feet in most places. A small included acreage differs in having lost a considerable part of the original surface layer as a result of accelerated erosion.

Use and management.—All but a few acres of Ramsey stony fine sandy loam, hilly phase, is still in forest. Most of the cleared acreage is in pasture, but some is reverting to forest.

This soil is poorly suited to crops because it is stony, low in fertility, and susceptible to erosion. It is also poorly suited to pasture, but fair to good pasture can be established and maintained under a high level of management. The soil is deficient in lime, phosphate, nitrogen, and potash for most crop and many pasture plants. Good pasture management includes the use of adequate quantities of lime, phosphate, and potash. Legumes in the pasture should supply most of the nitrogen needed. Weed control is a problem, for it is difficult to clip the pasture.

Roanoke silt loam (Rd).—Areas of this soil occur on nearly level to slightly depressional parts of the low stream terraces. Drainage, both internal and external, is slow to very slow. The soil has formed from old alluvium washed largely from uplands that are underlain by granite but includes a small admixture of a wide variety of materials in most places. The soil is closely associated with Masada and Altavista soils and differs from them chiefly in being more poorly drained.

Profile description:

0 to 8 inches, light-gray friable silt loam with a weak medium crumb structure.

8 to 16 inches, moderately plastic silty clay to silty clay loam mottled with gray and yellow and having a moderately well developed medium blocky structure.

16 inches +, compact clay highly mottled with gray, yellow, rust, brown, and black; the terrace deposit is 5 or more feet thick.

Organic-matter content is apparently low, reaction is medium to strongly acid throughout, and content of most plant nutrients is low. The soil waterlogged for extended periods, preventing normal air circulation and root penetration. It is very slowly permeable to water and full of stones and gravel.

As mapped, small areas of soils are included that vary greatly in color (gray to yellow) and drainage (poor to imperfect). Some poorly drained areas differ in not having the typical slowly permeable compact clay subsoil; their poor drainage is due largely to seepage.

Use and management.—Most of Roanoke silt loam is cleared and used for corn, hay, and pasture. Some of the cleared land is idle. Crop yields are very low, and complete failures are common. Owing chiefly to poor drainage, this soil is not considered suited to crops. The supply of lime and of most major plant nutrients is deficient, and very poor quality pasture is produced. Response to good management is neither very great nor lasting. Artificial drainage is difficult and of doubtful practicability.

Rough gullied land (Ashe and Porters soil materials) (Re).—This land type includes badly gullied areas that were originally covered by one of the soils developed from granite materials, as the Ashe or Porters. These areas have been reduced to an intricate pattern of gullies in which very little of the former soil remains. Bed-

rock outcrops are common in some places, but the soil material is several feet thick in others. Slopes range from about 25 to 60 percent. Most of the acreage is in the Porters-Tusquitee-Balfour and Ashe-Tusquitee-Perkinsville soil associations.

Use and management.—Rough gullied land (Ashe and Porters soil materials) is very poorly suited to crops or pasture. It is also very poorly suited to forest, which is its most practical use on many farms. White pine and black locust do well and can be expected to stabilize erosion within a few years.

Rough gullied land (Dandridge soil material) (RF).—This badly gullied land was originally covered by Dandridge soils. The gullies cover 40 to 100 percent of the surface and are usually less than 3 feet deep. Soft black calcareous shale bedrock is exposed in most areas, and little soil material remains. The slopes range from 15 to 60 percent. Areas are very small and mostly in the Dandridge-Hamblen soil association.

Use and management.—Under ordinary conditions, it is unwise to attempt to reclaim this land for either pasture or crops. It should be allowed to revert to woodland and thereafter be maintained in woodland if possible. As the shale is calcareous, black locust can be expected to do well.

Rough gullied land (Dunmore and Fullerton soil materials) (RG).—Badly gullied areas, originally covered by Dunmore, Fullerton, or some other soil developed from limestone residuum, compose this land type. The land has been reduced to an intricate pattern of gullies in which little of the former soil layers remains. The silty clay parent material is nearly everywhere exposed. Outcrops of limestone are common in some places, but in most the soil material is several feet thick. Slopes range from 7 to 40 percent. Most of this type is in small conspicuous areas in the western part of the county; it is in association with Dunmore, Fullerton, Groseclose, and Decatur soils.

Use and management.—Practically all areas of this land are abandoned, and many are reverting to forest. On most farms reforestation is the chief practical means of reclaiming the soil. Shortleaf pine, which tends to establish itself by natural reproduction, or black locust, which has to be planted, are both useful for reforestation.

Sequatchie loam (SB).—The parent material of this soil of the low stream terraces consists mainly of general alluvium washed largely from uplands underlain by quartzite, sandstone, shale, and slate but does contain a small admixture of material from limestone. The soil is underlain by limestone or calcareous shale at a depth of 5 feet or more. Slopes range from 1 to 5 percent, and some included areas have slopes of 5 to 15 percent. External and internal drainage are moderate. This soil is in small irregularly shaped areas closely associated with Staser, Hamblen, Hayter, Allen, Jefferson, Nolichucky, and other Sequatchie soils.

Profile description:

0 to 12 inches, light-brown or grayish-brown very friable loam.
12 to 30 inches, yellowish-brown to brownish-yellow friable light clay loam.
30 inches +, brownish-yellow very friable sandy loam or sandy clay loam splotched with gray, yellow, and brown in most places.

The soil is medium to strongly acid, seems moderately high in organic matter, and is moderately well supplied with most plant nutrients. Locally there are a few cobblestones on the surface and throughout the soil, but these do not interfere with cultivation. Good tilth is easily maintained, and tillage can be carried on over a fairly wide range of moisture conditions. Plant roots penetrate the soil readily, and air and moisture circulate freely. Moisture-holding properties are relatively poor, but the supply of moisture for growing plants is ordinarily adequate.

Use and management.—All of Sequatchie loam has been cleared and used for crops and pasture. About 30 percent is used for corn, 15 percent for small grain, 30 percent for hay crops, 10 percent for pasture, 10 percent for miscellaneous crops (including vegetables and tobacco). About 5 percent of the land is idle.

Systematic rotations are not commonly practiced. Row crops and small grains are grown for a few years, followed by a few years of hay or pasture. Tobacco and truck crops receive moderate to large quantities of complete fertilizer, and corn and small grains receive small applications. Hay crops are not ordinarily fertilized. Very little lime is used. Corn yields 40 bushels; wheat, 18 bushels; red clover hay, 1.4 tons; and tobacco, 1,425 pounds an acre under the prevailing system of management.

This soil is well suited to a wide variety of crops and can be used intensively for intertilled crops if adequately limed and fertilized. It is somewhat deficient in lime, phosphate, potash, and nitrogen for high yields of most crops but responds readily to their application. It can be maintained under a short rotation that includes a deep-rooted legume to supply the needed nitrogen. Susceptibility to erosion is only slight; and when crops are rotated and adequately fertilized, no special practices for controlling runoff are necessary.

Sequatchie gravelly loam (Sa).—This well-drained gravelly soil occupies 1- to 10-percent slopes on low stream terraces. Its parent material consists of general alluvium washed from Ramsey, Allen, Jefferson, and associated soils. In most places, it includes a small admixture of material washed chiefly from Decatur or Dunmore soils. Areas are closely associated with Staser, Hamblen, Allen, Jefferson, Nolichucky, and other Sequatchie soils. Surface runoff is slow.

This soil differs from Sequatchie loam chiefly in having sufficient gravel on the surface and throughout the soil to interfere with tillage. The surface soil is grayish-brown or light-brown gravelly loam, and the subsoil is yellowish-brown or brownish-yellow gravelly light clay loam. Included with this soil are some soils formed from alluvium that contains a considerable admixture of granite material.

Use and management.—All of Sequatchie gravelly loam has been cleared and cultivated. About 30 percent is in corn, 10 percent in small grain, 35 percent in hay crops, 15 percent in pasture, and 10 percent in other crops or idle. Crops are not systematically rotated, nor is fertilizer commonly applied to crops other than tobacco and vegetables. Tobacco and vegetables usually receive moderate to heavy applications of a complete fertilizer; other crops receive light applications at infrequent intervals. Little of the soil is ever limed. Under prevailing practices acre yields are 30 bushels of corn, 14 bushels of wheat, and 1.2 tons of red clover hay.

The soil is well suited to all the common crops of the county. It is moderately productive and is responsive to good management, but the high gravel content materially interferes with tillage. The soil is deficient in lime, phosphate, nitrogen, and potash for continued high yields of most crops. A short rotation that includes a deep-rooted legume is desirable. Pasture does well if properly fertilized (pl. 5, *B*). The problem of erosion control is negligible.

Staser fine sandy loam (Sc).—Most of this soil is subject to overflow. Areas are on nearly level flood plains, chiefly in the vicinity of Hunter and Happy Valley School. They are closely associated with Hamblen, Sequatchie, Allen, and Jefferson soils. The parent material consists of mixed general alluvium washed chiefly from Dandridge and Ramsey soils. It includes quartzite, sandstone, shale, slate, and, in some places, limestone material. The soil differs from Hamblen loam chiefly in being better drained; consequently, it is free of mottlings to a greater depth. Surface runoff is slow, but internal drainage is moderate.

Profile description:

0 to 14 inches, grayish-brown or light-brown very friable loose fine sandy loam.
14 to 24 inches, yellowish-brown friable heavy loam or fine sandy loam.
24 inches +, brownish-yellow sandy loam splotched with gray below about 36 inches.

The soil is slightly acid in most places, but some areas are included that are medium to strongly acid. Content of organic matter and most plant nutrients is apparently moderately high. Plant roots penetrate the soil easily, and air and water circulate freely. Water is readily absorbed and fairly well retained. Some gravel and cobbles are on the surface and throughout the profile but they do not interfere with tillage.

Use and management.—Staser fine sandy loam is used chiefly, and in many places continuously, for corn. Hay crops are grown to some extent, and small acreages of small-grain and truck crops. Fertilizer is not ordinarily applied. Under common management practices, corn yields 45 bushels an acre; wheat, 11 bushels; and red clover hay, 1.3 tons.

This soil is well suited to intensive use, especially for corn and many hay crops. Susceptibility to flooding restricts its use suitability, but the floods help maintain fertility by depositing material high in organic matter and plant nutrients. Small-grain crops tend to lodge, mature late, and be susceptible to disease. Productivity is relatively high, but yields could be increased by applying phosphate and using a short rotation.

State loam (Sd).—The parent material of this soil consists of old alluvium washed chiefly from uplands underlain by granite. Most of the material washed from Ashe, Porters, and associated soils, though in many places some washed from Ramsey soils. In many characteristics the soil is similar to Sequatchie loam, yet it differs in character of parent material. In this county the soil is underlain chiefly by calcareous shale and to a less extent by limestone and granite. Areas occupy 2- to 7-percent slopes on nearly level or gently sloping low stream terraces and are closely associated with Congaree, Masada, Hiwassee, and Buncombe soils. Surface runoff is slow to moderate, and internal drainage is moderate.

Profile description:

0 to 10 inches, brown to grayish-brown very friable loose loam.
10 to 32 inches, yellowish-brown to brownish-yellow friable clay loam with a weak medium-blocky structure.
32 inches +, brownish-yellow clay loam to loamy sand, in most places stratified and consisting of variable coarse-textured material.

The soil is medium acid, well supplied with organic matter, moderately high in most plant nutrients, and very permeable to plant roots, air, and water. A few cobblestones or some gravel is on the surface and throughout the soil in many places, but not in quantities sufficient to interfere with tillage. Rainfall is readily absorbed and well retained. The entire soil contains a moderate quantity of small mica flakes.

Use and management.—Practically all of State loam has been cleared and used for crops or pasture. About 30 percent is in corn, 20 percent in small grain; 35 percent in hay and pasture, and 10 percent in other crops, including tobacco, potatoes (pl. 6, *A*), and vegetables. Approximately 5 percent of the land is idle. Crops are not commonly systematically rotated, but a few farmers follow a 3-year rotation of corn, small grains, and hay. Tobacco and truck crops receive moderate to heavy applications of a complete fertilizer on most farms; other crops receive only light applications. Recently, use of lime and phosphate on hay crops and pasture has become a more common practice. Under the prevailing management, corn yields 40 bushels an acre; wheat, 14 bushels; and red clover hay, 1.4 tons.

This soil, one of the most productive in the county, is well suited to practically all the common crops of the area and responds well to good management. In places it is a little too low in lime, phosphate, and possibly potash to produce continued high yields of many crops. The nitrogen requirement depends largely on the crop grown and the past cropping system. Presumably the soil can be maintained under a short rotation that includes a deep-rooted legume. The problem of runoff control is negligible.

Stony colluvium (Tusquitee and Jefferson soil materials) (Se).—Small alluvial or colluvial fans and sloping areas at the base of steep mountain slopes are occupied by this soil. Slopes range from 2 to 30 percent. The small areas are widely distributed in the mountainous section. The soil material has washed from the associated Ashe, Porters, or Ramsey soils of the mountain uplands and is similar to that from which the Tusquitee and Jefferson soils are formed. Rocks and cobblestones on the surface and throughout the soil make tillage impractical (pl. 7, *A*). The rocks are of various sizes and may range up to several feet across. Some are somewhat rounded; others are angular.

Use and management.—This stony soil is unsuited to crops and poor for pasture. Fair pasture can be obtained, but weeds are hard to control. If enough lime and phosphate is applied, much better pasture is obtained.

Stony hilly land (Dunmore soil material) (Sf).—This land type is commonly referred to as rockland or limestone rockland. In most places outcrops and ledges of limestone bedrock occupy 10 to 60 percent of the surface. The soil material between the rocks—similar to that of the Dunmore soils—varies from silt loam to silty clay, from

a few inches to several feet in depth to bedrock, and from brownish yellow to reddish brown. Slopes range from 15 to 30 percent. Areas occur in that part of the county underlain by limestone, but the largest acreage is in the Stony land-Fullerton-Clarksville soil association.

Use and management.—About 50 percent of Stony hilly land (Dunmore soil material) is cleared and used for pasture. The rest has a forest cover in which redcedar is generally conspicuous. Much of this land, particularly the steeper and stonier areas, probably should remain in forest. Stoniness precludes its use for cultivated crops, but the soil produces good early spring pasture. Bluegrass does well and is at its best in spring, early in summer, and in fall. Lime is necessary for good growth of pasture plants in many areas, and phosphate would improve the growth almost everywhere. The rocky surface does not allow the use of mowing machines and this is a real handicap in weed control.

Stony rolling land (Dunmore soil material) (SG).—The local terms "rockland," "limestone rockland," or "glady land" are applicable to this land type because the many outcroppings and ledges of limestone rock occupy 10 to 50 percent or more of the surface. The depth of the soil material between the ledges and outcrops varies considerably, the deepest parts usually being farthest from the rock outcrops. Most of the soil material between the rocks resembles that of the Dunmore soils. It varies from silt loam to silty clay in texture, from a few inches to several feet in depth, and from yellow to reddish brown in color. Slopes range from 7 to 15 percent.

This land is widely distributed throughout that part of the county underlain by limestone. It is closely associated with Dunmore, Decatur, Fullerton, Clarksville, and Groseclose soils and with other stony land types.

Use and management.—Stoniness definitely precludes use of this land for cultivated crops, but it is suitable for pasture and produces some of the earliest spring pasture in the county (pl. 6, *B*). Bluegrass does well early in spring and late in fall when moisture conditions are favorable. Lime is necessary for good growth of pasture plants in many places, and phosphate would improve growth nearly everywhere. Weed control is very difficult because stones prevent the use of mowing machines in clipping pasture. Some included areas are too stony for any use except forest.

Stony rough land (Dunmore and Teas soil materials (SH).—Locally known as limestone land or red slate land, this land type is characterized by numerous ledges and outcroppings of limestone rock or highly calcareous purple shale. About 75 percent of the land is underlain by limestone and 25 percent by calcareous shale. Outcrops and ledges occupy from 20 to 70 percent of the surface. The soil material covering the rocks and between the ledges and outcroppings is shallow; it ranges from a few inches to about 3 feet deep and is brownish yellow to purplish brown. Slopes normally range from 30 to about 60 percent in gradient, but a few are in excess of 60 percent.

Use and management.—More than 80 percent of this land is in forest, its best use. Much of the forest consists of a sparse growth of drought-resistant species, mostly redcedar.

Stony rough land (Porters and Ashe soil materials) (Sk).—This soil occupies steep and rocky slopes on practically all mountains of granite and gneiss. Slopes range from 20 to more than 60 percent. The land is characterized by ledges and outcroppings of granitic rocks; outcrops and boulders cover 20 to 70 percent of the surface. The soil material (Porters or Ashe) between the rocks ranges from a few inches to about 3 feet in depth.

Use and management.—The land is almost entirely in forest, predominantly hardwoods, with scattered areas of hemlock and pine. Forest is its best use. The greater part is within the Cherokee National Forest.

Stony rough land (Ramsey soil material) (Sl).—Steep and rocky mountain slopes of 16 to more than 60 percent gradient are occupied by this soil. It is characterized by many bedrock outcrops and loose boulders, which occupy 20 to 70 percent of the surface in most places, and would prohibit tillage even if it were otherwise feasible. The rocks consist of quartzite, fine-grained sandstone, sandy and argillaceous shale, and slate. Ramsey soil material, a few inches to 2 or 3 feet deep in most places and highly variable in texture and color, occupies spaces between the rocks and boulders.

Use and management.—The land is almost entirely in forest, dominantly hardwoods, with scattered areas of hemlock and pine. Forest is the best use. A large part lies within the present boundaries of the Cherokee National Forest.

Tate loam, rolling phase (Tb).—This soil lies at the base of steep mountain slopes. It formed from colluvium or local alluvium washed chiefly from Ashe and Perkinsville soils but in places includes some material from closely associated soils. Slopes range from 5 to 12 percent. Areas are small, irregularly shaped, and widely distributed throughout that part of the county underlain by granite and gneiss. They are closely associated with Ashe and Perkinsville soils and to a less extent with Porters, Balfour, Tusquitee, and Chewacla soils. External drainage is moderate, and internal drainage is moderate to slow.

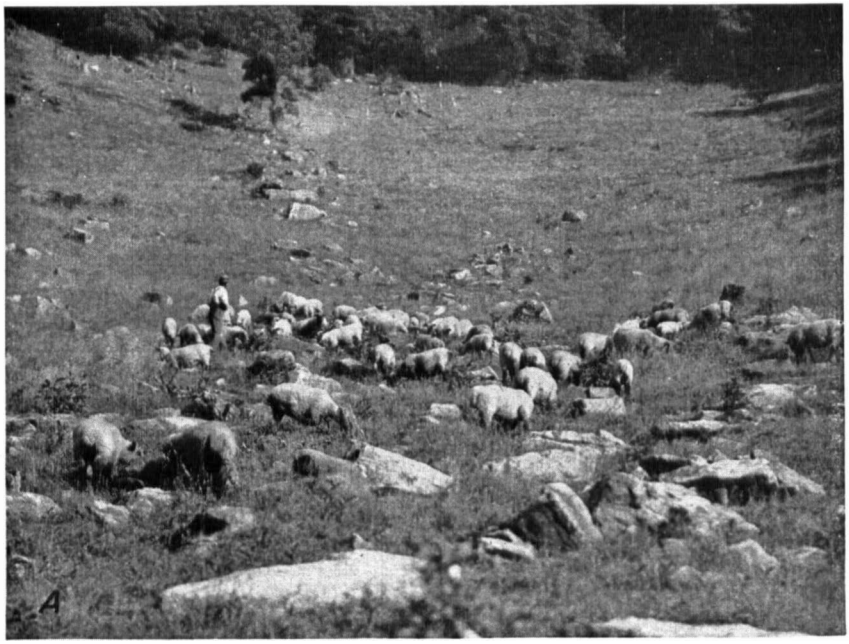
Profile description:

0 to 12 inches, light-brown to grayish-brown very friable loam.
12 to 28 inches, yellowish-brown to light yellowish-brown friable clay loam with a weak medium blocky structure; lower part may be faintly splotched with gray and yellow.
28 inches +, light yellowish-brown to pale-yellow friable heavy loam or clay loam splotched with gray and yellow.

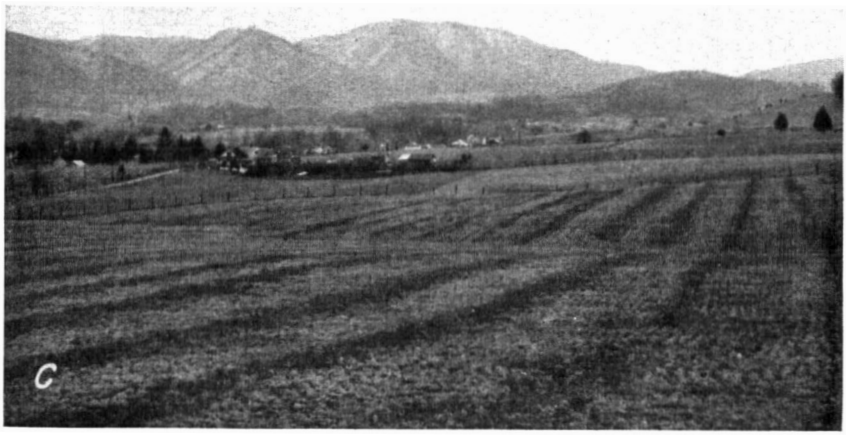
This soil is medium to strongly acid, moderately low in organic matter and most plant nutrients, and relatively high in water-holding capacity. A few stones, not enough to interfere with tillage, are on the surface and throughout the soil in most places. Seepage from the adjacent slopes keeps the lower soil layers saturated part of the time. The soil is permeable to air, roots, and water.

As mapped, this soil includes small areas of the associated Tusquitee, Chewacla, and Congaree soils. A small area in the vicinity of Poga School differs in having a gray surface soil and in being stony. Some small areas are also included that are moderately eroded.

Use and management.—Practically all of Tate loam, rolling phase, has been cleared and cultivated. Much of it is now in pasture, and some is reverting to forest. An estimated 15 percent is used for corn,



A, Sheep grazing on Stony colluvium (Tusquitee and Jefferson soil materials). *B*, Barley planted in contour furrows on Clarksville cherty silt loam, eroded hilly phase.



A, Pasture demonstration on Nolichucky soils: Rye and permanent pasture mixture on right received 2 tons of lime and heavy application of 15–30–15; area on left received no amendments.

B, Landscape of Jefferson-Allen-Sequatchie association; Sequatchie and Hamblen soils in foreground, Jefferson and Allen soils in cleared background, and Ramsey soils of Ramsey-Jefferson-Matney association in background.

C, Jefferson-Masada-cobbly alluvium association in a covelike valley.

5 percent for small grain, 30 percent for hay, 30 percent for pasture, and 5 percent for other crops. About 15 percent of the land is idle. Crops are not systematically rotated, and fertilization is not a common practice except on truck crops. Under prevailing management practices, corn produces 40 bushels an acre; cabbage, 12 tons; and red clover hay, 1.2 tons.

This soil is moderately well suited to crop production and well suited to pasture. Given proper and adequate fertilization, most of the common crops can be successfully grown. Vegetable crops, such as beans and cabbage, are very well suited. Owing to favorable moisture conditions and moderately cool summer temperatures, excellent pasture can be maintained if it receives adequate applications of lime and phosphate. The soil is deficient in lime, phosphate, and nitrogen but presumably has an adequate supply of potash for most crops. It responds well to fertilization. It can usually be maintained in a rotation of moderate length that includes grasses and legumes. Susceptibility to erosion is moderate; contour tillage should be practiced where feasible.

Tate loam, hilly phase (TA).—This well to moderately well drained soil of the colluvial lands formed from materials washed or rolled from uplands underlain by granite or gneiss. It differs from the rolling phase chiefly in having a stronger slope (12 to 30 percent). Most of the acerage is in the Ashe-Tusquitee-Perkinsville soil association. Areas are closely associated with Ashe, Perkinsville, Chewacla, and to a less extent with Porters soils. The surface soil is light-brown to grayish-brown very friable loam, and the subsoil is light-brown to light yellowish-brown clay loam.

Some areas included with this soil contain sufficient stones to interfere materially with tillage. Some areas are also moderately eroded; about 20 to 50 percent of the original surface soil has been lost as a result of accelerated erosion.

Use and management.—Most of Tate loam, hilly phase, has been cleared and used for crops and pasture. At present, it is chiefly in hay crops and pasture, but a small acreage is used for crops. An estimated 20 to 25 percent is idle, a part of which is reverting to forest. Some hay crops and pasture receive light applications of lime and phosphate, but this is not a common practice. Yields are low and of poor quality on unfertilized pasture.

Owing to strong slope, low fertility, and susceptibility to erosion, this soil is poorly suited to intertilled crops. It is best suited to semipermanent hay crops or pasture. Good pasture can be established and maintained under a management system that includes adequate applications of lime and phosphate and carefully controlled grazing. If the soil must be used for crops, a long rotation is desirable. All cultivation should be on the contour.

Teas-Litz silt loams, hilly phases (TH).—This complex is characterized by two soils—Teas silt loam, hilly phase, and Litz silt loam, hilly phase—so intricately associated geographically that it is not practical to delineate each one separately on the soil map. Teas soils are on about 25 percent of the area, and Litz soils on 40 percent; the soils on the rest of the area are intermediate in characteristics between the two. These soils of the uplands are derived from residuum of interbedded limestone and shale. Slopes range from 15 to 30 percent.

Areas are on rounded or dome-shaped hills in the Teas-Litz-Camp soil association. They are closely associated with Camp, Jefferson, Allen, Hayter, and Hamblen soils. Surface runoff is rapid to very rapid, and internal drainage is moderately slow.

Profile description of Teas silt loam, hilly phase:

0 to 7 inches, purplish-gray friable silt loam; in wooded areas the surface inch stained dark with organic matter.
7 to 20 inches, purplish-red moderately friable shaly silty clay loam.
20 inches +, light purplish-red friable shaly heavy silt loam; bedrock, which is at depths of 2 to 5 feet, consists of purplish shale interbedded with limestone; the shale is calcareous in places.

Profile description of Litz silt loam, hilly phase:

0 to 8 inches, grayish-yellow friable silt loam; in wooded areas the 1-inch surface layer is stained medium gray with organic matter.
8 to 20 inches, brownish-yellow to yellow moderately friable shaly silty clay loam lightly splotched with gray and yellow.
20 inches +, shaly silty clay loam to silty clay highly mottled with red, brown, yellow, and gray; bedrock, which is at depths of 2 to 5 or more feet, consists of light-colored shale interbedded with limestone.

These soils are slightly to strongly acid in most places. They are neutral in a few small areas, especially where partly weathered calcareous shale fragments are scattered throughout the soils. In many places the surface soil is strongly acid, the subsoil medium acid, and the underlying material about neutral. Organic-matter content appears to be moderately low; content of many plant nutrients, especially phosphorus, is low. Some flaggy shale fragments are on the surface and throughout the soils but not in quantities sufficient to interfere with tillage. The water-holding capacity is low, chiefly because the soils are relatively shallow to bedrock.

Use and management.—Practically all of Teas-Litz silt loams, hilly phases, is forested. The complex is not suitable for intertilled crops, largely because of its low fertility, low water-holding capacity, and strong slope. It is suitable for pasture, but as many areas are associated with soils not suited to such use, it is probably best used for forest on many farms. Cleared areas are highly susceptible to erosion, and it is advisable to establish pasture sod as soon as possible after removing forest. Lime and phosphate are required to establish and maintain good pasture.

Teas-Litz shaly silty clay loams, eroded hilly phases (Tm).—An estimated 40 percent of this complex is Teas soils, and about 60 percent is Litz soils. These soils have formed from weathered materials of interbedded shale and limestone. Slopes are 15 to 30 percent in gradient. Areas are widely distributed throughout the Teas-Litz-Camp soil association and are closely associated with Camp, Hamblen, Allen, Jefferson, Hayter, Ramsey, and Ashe soils.

This complex differs from Teas-Litz silt loams, hilly phases, chiefly in being eroded. A considerable part of the original surface layer has been lost, and there has been some mixing of the remnants with the subsoil in the plow layer. This mixing has resulted in a surface layer that is significantly heavier in texture and more variable in color and thickness. In many small spots all the original surface layer is missing and the subsoil is exposed. With the loss of the finer materials there has also been an accumulation of fine shale fragments in the surface layer, but these fragments do not seriously interfere with tillage.

Use and management.—Practically all of Teas-Litz shaly silty clay loams, eroded hilly phases, has been cleared and used for crops and pasture. About 20 percent is in corn, 10 percent in small grain, 30 percent in hay crops, 25 percent in pasture, and 5 percent in other crops; about 10 percent is idle. No regular system of crop rotation prevails, and fertilization is generally not adequate for high yields. Crop and pasture yields are moderately low under present management.

This complex is considered better suited to permanent pasture than to crops, although presumably it could be maintained for crops under a high level of management. Rotations should be long and consist chiefly of close-growing crops, preferably deep-rooted legumes and grasses. Adequate fertilization and contour tillage are also necessary if productivity is to be maintained or increased. Good pasture can be established and maintained fairly easily, but applications of lime and phosphate are needed in most places.

Teas-Litz shaly silty clay loams, eroded steep phases (TN).—Teas shaly silty clay loam, eroded steep phase, and Litz shaly silty clay loam, eroded steep phase, compose this complex. It differs from Teas-Litz silt loams, hilly phases, chiefly in being eroded and in having steeper slopes (30 to 60 percent). This complex, in general, is also shallower, and bedrock outcrops are more common. Areas are widely distributed in the Teas-Litz-Camp soil association.

A considerable part of the original surface layer has been lost through accelerated erosion, and mixing of subsoil material with remnants of the original surface layer has resulted in a significantly heavier textured layer more variable in color and thickness. The finer separates have been removed, and the shale fragments have accumulated in the surface layer.

Use and management.—All of this complex has been cleared and used for crops and pasture. Most areas are now in pasture, but some are used for crops; a considerable part is idle. A part of the idle land is reverting to forest. Crop and pasture yields are generally low.

Owing to steepness, shallow depth, low fertility, low water-holding capacity, and susceptibility to erosion, this complex is very poorly suited to crop production and poorly suited to pasture. On many farms it should be allowed to revert to forest. Where this soil is required for pasture, fair pasture can be established and maintained if grazing is carefully controlled and adequate quantities of lime and phosphate are applied.

Teas-Litz shaly silt loams, steep phases (TK).—This complex consists of Teas shaly silt loam, steep phase, and Litz shaly silt loam. steep phase, intricately associated geographically. The soils have formed from the weathered materials of interbedded shale and limestone. The complex differs from Teas-Litz silt loams, hilly phases, chiefly in having steeper slopes (30 to 60 percent), but also in being shallower, having even less distinct surface soil and subsoil layers, and in having more shale fragments on the surface and throughout the profile. An occasional bedrock outcrop is common. This complex is widely distributed throughout the Teas-Litz-Camp soil association and is closely associated with Ramsey, Allen, Jefferson, Masada, Nolichucky, Fullerton, and Dunmore soils.

Use and management.—Forest, predominantly hardwood but including some white pine and hemlock, covers this complex. Both

soils of the complex are low in fertility, low in water-holding capacity, and very susceptible to erosion when cleared. The land is very poorly suited to crops and poorly suited to pasture; forest is its best use on most farms.

Teas-Litz shaly silt loams, very steep phases (TL).—This complex—the very steep phases of Teas and Litz shaly silt loam—differs from the complex of Teas-Litz silt loams, hilly phases, chiefly in having slopes greater than 60 percent. It is also shallower and has many more bedrock outcrops. Small partly weathered shale fragments are more numerous on the surface and throughout the profile. The small acreage of this complex occurs throughout the Teas-Litz-Camp soil association.

Use and management.—All of Teas-Litz shaly silt loams, very steep phases, is in forest, predominantly hardwood. Forest is its best use. The very steep slopes practically prohibit use for either crops or pasture. For a discussion on forest management, see the section on Forests.

Teas-Litz silty clay loams, eroded rolling phases (To).—This is a complex association of eroded rolling phases of Teas and Litz soils, each composing an estimated 50 percent of the area. These soils have formed from weathered materials of interbedded shale, chiefly calcareous, and limestone. The small areas are chiefly on ridge crests. They are widely distributed throughout the Teas-Litz-Camp soil association in close association with Camp, Allen, Jefferson, Ramsey, Fullerton, and Dunmore soils. Slopes range from 7 to 15 percent.

This complex differs from Teas-Litz silt loams, hilly phases, mainly in being eroded and in having milder slopes. In most places, the depth to bedrock is greater, the surface soil and subsoil layers are more distinct, and fewer shale fragments are on the surface and throughout the profile. From 25 to 60 percent of the original surface layer has been lost as a result of accelerated erosion. The remnants have been mixed with subsoil material in the plow layer, and the present surface layer is significantly heavier in texture and more variable in thickness and color.

Use and management.—About 90 percent of Teas-Litz silty clay loams, eroded rolling phases, has been cleared and used for crops and pasture. Of this cleared land, about 20 percent is used for corn, 15 percent for small grain, 25 percent for hay crops, 25 percent for pasture, and 5 percent for other crops (including tobacco). Approximately 10 percent of the cleared land is idle or used for nonfarm purposes. Normally, crops are not systematically rotated, but a few farmers follow a 4-year rotation of corn, small grains, clover, and grass. Tobacco and truck crops receive moderately heavy applications of a complete fertilizer; other crops receive only light applications or none at all. Some lime and phosphate are used on hay crops and pasture. Acre yields under prevailing management are 13 bushels of corn, 5 bushels of wheat, and 0.7 ton of red clover hay.

This complex is moderately well suited to crops and pasture. The soils are more acid than the hilly and steep phases, and liming is necessary for many crops, especially deep-rooted legumes. Supplies of phosphate and nitrogen are too low for high yields of most crops, and potash may be slightly deficient for some. For crops susceptible to drought or those that mature in dry summer and fall, the moder-

ately low water-holding capacity will ordinarily limit response to good management. Chiefly for this reason, small-grain crops produce proportionately higher yields than corn. This complex is moderately susceptible to further erosion and to great injury from erosion. All tillage should be on the contour if feasible. On most farms a moderate to long rotation made up mainly of grass and legume crops is necessary if productivity is to be maintained.

Teas shaly silt loam, hilly phase (Tc).—The parent material of this upland soil weathered from purplish-red shale interbedded with limestone. The shale is calcareous in most places. Characteristically, the soil occupies 15- to 30-percent slopes on rounded or domelike hills. It is widely distributed in the Teas-Litz-Camp soil association, where it is closely associated with Litz, Camp, Allen, Jefferson, Masada, Nolichucky, Fullerton, and Dunmore soils. Surface runoff is rapid, and internal drainage is moderately slow.

Profile description:

0 to 8 inches, purplish-gray friable shaly silt loam; in wooded areas the surface inch is stained dark with organic matter.

8 to 20 inches, purplish-red moderately friable shaly silty clay loam with a moderately well developed medium to coarse blocky structure.

20 inches +, light purplish-red friable shaly silty clay loam containing many partly disintegrated shale fragments; bedrock at depth of 2 to 5 feet in most places.

This soil is slightly to strongly acid; in most places, the surface soil is strongly acid, the subsoil medium acid, and the underlying material about neutral. Organic-matter content is relatively low, and content of many plant nutrients, especially phosphorus, is low. Flaggy shale fragments are on the surface and throughout the soil, but not in numbers sufficient to interfere materially with tillage. Bedrock crops out occasionally. The water-holding capacity is low, chiefly because the soil is shallow to bedrock.

Use and management.—All of Teas shaly silt loam, hilly phase, is in forest, but it is considered suitable for pasture. Strong slopes, low fertility, and low water-holding capacity make it poor for crops. Good pasture can be established and maintained by applying enough lime and phosphate. The soil is highly deficient in phosphorus, only slightly deficient in lime for high yields of many crops, and adequate in supply of potash for most crops. Susceptibility to erosion is high when the soil is cleared; establishing pasture sod as soon as possible after clearing is advisable. Many areas are relatively inaccessible and therefore not suitable for pasture.

Teas shaly silt loam, steep phase (Td).—This excessively drained soil of the uplands, locally known as red rock, derives largely from calcareous shale. It differs from the hilly phase principally in having steep slopes (30 to 60 percent), but also has less distinct surface soil and subsoil layers, is shallower, and contains more bedrock outcrops. The surface soil is purplish-gray friable shaly silt loam; the subsoil, purplish-red moderately friable shaly silty clay loam. Areas are widely distributed in the Teas-Litz-Camp soil association, closely associated with Camp, Litz, Allen, Jefferson, Ramsey, and other Teas soils.

Use and management.—All of Teas shaly silt loam, steep phase, is still forested. Much of it is in the Cherokee National Forest. Hardwoods predominate but some white pine and hemlock is included.

Steepness, low fertility, low water-holding capacity, and susceptibility to erosion, make this soil very poor for crops and poor for pasture. Fair pasture can be maintained under a high level of management, but on most farms forest is probably the best use.

Teas shaly silt loam, very steep phase (TE).—This soil is derived from residuum of shale or interbedded shale and limestone. It is largely in the Teas-Litz-Camp soil association. It differs from the hilly phase chiefly in having much steeper slopes (above 60 percent). In general, it is shallower and has more bedrock outcrops. Depth to bedrock ranges from 1 to 4 feet. The surface layer is purplish-gray friable shaly silt loam; the subsoil, purplish-gray to purplish-red shaly silt loam or silty clay loam.

Use and management.—All except a few acres of this very steep phase is in forest, its best use. The very steep slopes practically prohibit production of either crops or pasture. For a discussion of forest management, see the section on Forests.

Teas shaly silty clay loam, eroded hilly phase (TF).—This well to excessively drained soil of the uplands has formed from residuum of interbedded purple shale and limestone. It differs from Teas shaly silt loam, hilly phase, chiefly in being eroded. It occupies 15- to 30-percent slopes in the Teas-Litz-Camp soil association.

About 25 to 75 percent of the original surface soil has been removed by accelerated erosion. In places all the surface soil is gone and the subsoil is exposed. Remnants of the original surface soil have mixed with the subsoil to form a plow layer significantly heavier in texture, more variable in thickness (3 to 7 inches), and more variable in color (purplish-gray to purplish-red friable shaly silty clay loam). The subsoil is purplish-red moderately friable shaly silty clay loam.

Use and management.—All of this eroded hilly phase is cleared and used for crops, chiefly hay, and pasture. A small part is idle. Some hay crops and pasture receive lime and phosphate, but this is not a common practice.

This soil is better suited to permanent pasture than to crops that require tillage. It is highly susceptible to erosion, low in fertility and water-holding capacity, and low in productivity for most crops. It is similar to the hilly phase of Teas shaly silt loam in use and management requirements; but owing chiefly to cropping and erosion losses, it is lower in fertility, lower in water-holding capacity, and more susceptible to further erosion.

Teas shaly silty clay loam, eroded steep phase (TG).—This excessively drained soil of the uplands is derived from residuum of calcareous shale or interbedded shale and limestone. It differs from Teas shaly silt loam, hilly phase, in being eroded and in having steeper slopes (30 to 60 percent). About 25 to 75 percent of the original surface soil has been removed by accelerated erosion, and in a few areas all the original surface soil has been lost and the subsoil exposed. This soil also differs in being shallower, in having less distinct surface soil and subsoil layers, and in having more bedrock outcrops. Areas are widely distributed in the Teas-Litz-Camp soil association.

Use and management.—Most of Teas shaly silty clay loam, eroded steep phase, is used for pasture and hay crops, but some is in crops.

A considerable part is idle, some of which is reverting to forest. This soil is very poorly suited to crops and poorly suited to pasture. It is low in fertility and water-holding capacity; steep; highly susceptible to erosion; and owing to shallow depth to bedrock, susceptible to great injury from further erosion. On most farms it is probably best suited to forest; but if additional pasture is needed, it can presumably be maintained under a high level of management.

Tusquitee loam, rolling phase (Tr).—The local alluvium or colluvium from which this soil has formed has washed or rolled from uplands underlain chiefly by granite. Most of the material is from Porters and Ashe soils. This soil is in small areas at the base of upland slopes, closely associated with Congaree, Chewacla, Porters, Ashe, and Tate soils. It occupies 5- to 15-percent slopes in the southwestern part of the county, chiefly in the Porters-Tusquitee-Balfour and Ashe-Tusquitee-Perkinsville soil associations. External and internal drainage are moderate.

Profile description:

0 to 4 inches, dark-brown or dark grayish-brown very friable loam apparently high in organic matter.
4 to 12 inches, brown friable loam or silt loam with a well-developed medium to coarse crumb structure.
12 to 36 inches, yellowish-brown friable light silty clay loam to clay loam with a moderately well developed medium granular structure.
36 inches +, brownish-yellow friable clay loam faintly splotched with gray in some places; the colluvial deposit is 2 to 10 feet or more deep.

This soil is medium acid, apparently relatively high in organic matter, and moderately well supplied with plant nutrients. It readily absorbs rainfall and retains it well. It is very permeable to air, roots, and water. A few stones, not enough to interfere with tillage, are on the surface and throughout the profile in many places. Variable quantities of mica flakes occur throughout the profile.

Much of this soil is moderately eroded. In most places 25 to 50 percent of the original surface soil, including the layer of higher organic-matter content, has been lost. Eroded areas are somewhat lower in organic matter, plant nutrients, and water-holding capacity, and more susceptible to further erosion than uneroded areas.

Use and management.—Practically all of Tusquitee loam, rolling phase, has been cleared and cultivated. About 30 percent is used for corn, 15 percent for small grain, 10 percent for other crops (including tobacco and vegetables), and 40 percent for hay crops and pasture. Approximately 5 percent of the land is idle. Systematic crop rotations are not common, though a number of different crops are grown. Most crops receive only light applications of fertilizer, but tobacco and truck crops receive heavier applications on many farms. Under the prevailing management, corn yields 40 bushels an acre; cabbage, 12 tons; and red clover hay, 1.2 tons.

This soil is well suited on crops and pasture and is productive of most of the common crops. Although naturally one of the most productive soils of the county, it still responds well to good management. Good tilth is easily maintained, and the soil can be tilled over a fairly wide range of moisture conditions. All types of farm machinery can be used, even though areas are generally small and irregularly shaped.

The soil is somewhat susceptible to erosion, and tillage should be on the contour where feasible. It can be maintained under a rotation of moderate length that includes legumes or legume-grass mixtures. Lime and phosphate are needed for continued high yields of most crops and are necessary for the successful growth of such crops as red clover and alfalfa. Nitrogen is needed for all except legume crops and the crops immediately following; potash is not generally required.

Tusquitee loam, undulating phase (Ts).—This well-drained soil of the colluvial lands formed at the base of upland slopes from local alluvium or colluvium washed chiefly from Porters or Ashe soils. It differs from the rolling phase chiefly in having milder slopes (2 to 5 percent). The surface soil is brown friable loam, and the subsoil is yellowish-brown friable silty clay loam or clay loam. The small areas are distributed throughout that part of the county underlain by granite. The Chewacla, Tate, Porters, and Ashe are closely associated soils.

Use and management.—All of Tusquitee loam, undulating phase, has been cleared and cultivated: About 25 percent is in corn, 15 percent in small grain, 30 percent in hay crops, 15 percent in pasture, and 10 percent in miscellaneous crops, including tobacco and vegetables; 5 percent is idle. Management is similar to that for the rolling phase, but yields are somewhat higher.

This soil is well suited to intensive use for crops. Good yields are obtained without amendments, but amendments are required to increase or even maintain present yields over a long period (pl. 6, *C*). Lime and phosphate are required for continued high yields of most crops and are essential for such crops as alfalfa and red clover. Except for legume crops and those immediately following, all crops need nitrogen. Potash supplies are adequate for all crops except possibly potatoes. Susceptibility to erosion is slight; special measures for water control are generally not needed. A short rotation that includes a deep-rooted legume is desirable.

Tusquitee loam, eroded hilly phase (Tp).—This well-drained soil has formed at the base of steep mountain slopes from local alluvium or colluvium washed mainly from Porters and Ashe soils. It differs from the rolling phase chiefly in being more eroded and in having steeper slopes (15 to 30 percent); however, in most places the colluvial deposit is somewhat shallower and soil characteristics are more variable. This soil is widely distributed throughout the Porters-Tusquitee-Balfour and Ashe-Tusquitee-Perkinsville soil associations.

The present surface soil, 4 to 10 inches thick, is brown to yellowish-brown friable loam. The subsoil is yellowish-brown friable clay loam. A part of the original surface layer, including that of higher organic-matter content, has been eroded away.

Use and management.—Practically all of this hilly phase has been cleared and cultivated. It is now used in much the same way as rolling phase, but not so intensively. Crop yields are appreciably lower.

Owing to hilly relief, this soil is only moderately well suited to crops. On most farms it is probably better suited to pasture or semipermanent hay crops. Very good pasture can be established and main-

tained under a management system that includes adequate applications of lime and phosphate. The soil is similar to the rolling phase in use and management requirements, but it is more exacting in choice and rotation of crops, fertilization, tillage practices, and water-control practices. Longer rotations consisting chiefly of close-growing crops, heavier fertilization, contour tillage, and possibly strip cropping are necessary to maintain or increase crop yields.

Tusquitee stony loam, rolling phase (Tu).—This soil has formed at the base of steep mountain slopes from local alluvial or colluvial material washed mainly from Porters and Ashe soils. It differs from Tusquitee loam, rolling phase, chiefly in being stony. Slopes range from 7 to 15 percent, but some included areas have 2- to 5-percent slopes. Surface runoff is moderate, and internal drainage is moderately rapid. The soil is widely distributed in the Porters-Tusquitee-Balfour and Ashe-Tusquitee-Perkinsville soil association. It is closely associated with Congaree, Chewacla, Porters, Ashe, and other Tusquitee soils.

Profile description:

0 to 10 inches, brown or grayish-brown friable stony loam.
10 to 32 inches, yellowish-brown friable stony clay loam.
32 inches +, brownish-yellow friable stony clay loam splotched with gray in some places; colluvial deposit from 2 to 10 feet deep.

This soil is medium to strongly acid, relatively high in organic matter, and moderately well supplied with plant nutrients. It is very permeable to air, roots, and water. Numerous stones, up to 10 inches across, are on the surface and throughout the soil mass in quantities sufficient to interfere with tillage. In some places the stones are so numerous as almost to prohibit tillage. Water is readily absorbed and moderately well retained.

Use and management.—About one-third of Tusquitee stony loam, rolling phase, is in forest, predominantly hardwood. Most cleared areas are in pasture, but some are used for crops, and a considerable part of the land is idle. Crops and pasture give fair yields without receiving amendments.

This soil is suitable for crops, but stoniness makes it much less desirable for that use than Tusquitee loam, rolling phase. In use and management requirements it is similar to that soil, but crop and pasture yields are lower.

Tusquitee stony loam, hilly phase (Tt).—Like the rolling phase of Tusquitee stony loam, this well-drained soil of the colluvial lands has formed at the base of steep mountain slopes from local alluvium or colluvium that washed mainly from Porters and Ashe soils. It differs from Tusquitee loam, rolling phase, chiefly in having steeper slopes (15 to 30 percent). Areas are widely distributed in the Porters-Tusquitee-Balfour and Ashe-Tusquitee-Perkinsville soil associations. The surface soil is brown stony loam; the subsoil, yellowish-brown clay loam.

Some eroded areas are included; these differ in having lost about 25 to 60 percent of the original surface soil as a result of erosion. A few small included areas have slopes of 30 to 60 percent.

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Use and management.—More than half of Tusquitee stony loam, hilly phase, has been cleared and used for crops or pasture. Most of the cleared area is now in pasture, but some is in crops and a considerable part is idle. Fair pasture is obtained under the prevailing management practices.

This soil is poor for crops but fair for pasture. The combination of hilly slopes and stoniness makes tillage difficult and also interferes with weed control on pasture. In some areas stones are so numerous they almost prohibit tillage. The soil is moderately fertile and will produce fair pasture without amendments. A fair to good response is expected from the use of lime and phosphate, and with adequate fertilization and carefully controlled grazing, good pasture can be established.

Wehadkee loam (WA).—This poorly drained soil developed mainly from general alluvium that washed chiefly from uplands underlain by granite or gneiss. In most places, however, it contains small admixtures of material from other sources. The alluvial deposit is four or more feet thick in most places. Areas are on stream bottoms and closely associated with Chewacla, Congaree, Tusquitee, Tate, Porters, and Ashe soils. They occur along most of the streams in or flowing from that part of the county underlain by granite.

Profile description:

0 to 10 inches, gray friable loam splotched with rust brown.
10 to 18 inches, gray loam to loamy sand mottled with rust brown and yellow.
18 inches +, gray or bluish-gray loam to loamy sand splotched with brown.

The soil is medium to strongly acid, low in organic matter, and moderately low in plant nutrients. Some gravel or cobblestones are on the surface and throughout the soil in most places, but they are not sufficiently numerous in the plow layer to interfere with tillage. Mica flakes appear throughout, but the quantity varies from place to place. The high-water table limits penetration of roots and circulation of air. Nonetheless, all of the soil layers are permeable or very permeable to air, roots, and water when the water table is sufficiently lowered. Crawfish are active, and their chimneys are common in many places. The soil is flooded frequently by the adjacent streams, consequently the water table is permanently high in most places. Seepage from upland slopes keeps the soil wet in places.

Use and management.—About 75 percent of Wehadkee loam has been cleared and cultivated or pastured. Most of it is now in pasture, but a significant acreage is idle, a part of which is reverting to forest. Pasture is generally of poor quality. A few acres have been drained artificially and are used for crops, mainly corn and hay.

In its present drainage condition, this soil is best suited to pasture and cannot be expected to respond well to fertilization. Water-tolerant hay crops or short-season summer-annual legumes can be grown with moderate success in most places. Artificial drainage can be expected to improve this soil for hay and pasture and widen its range in adaptation so as to permit growing of corn and some other crops. Drainage, however, is difficult.

USE AND MANAGEMENT[6] OF IMPORTANT GROUPS OF SOILS

The use suitability and management requirements of soils are closely interrelated. The properties of a soil limit the uses to which it is physically suited, and these uses determine the requirements for good management. Conditions of workability,[7] conservability,[8] and productivity [9] may determine the suitability of a soil for crops, pasture, or forest; but soils suited to the same broad use may differ considerably in management requirements. The 153 soils of this county differ one from another in one or more characteristics; consequently, they differ in varying degrees in use suitability and management requirements. Soils that are not greatly different and therefore have somewhat similar suitability for use and management requirements are grouped, and use and management practices are discussed for each of the 23 groups.

The management requirements of soils of each group are discussed for crops that require tillage and for permanent pasture. These requirements are somewhat similar among the soils of each group. Since management practices generally affect all crops in a rotation, management requirements of the soils are discussed in connection with rotations instead of individual crops.

Management practices that are good under existing conditions on many farms in the area are suggested as a general guide to those who will take proper account of the circumstances on the individual farm. They represent kinds of management that are thought to be good, but many different combinations of management practices can be used in most cases to attain the same production. The proper choice of management practices depends upon conditions of the farm as a unit. For example, nitrogen may be maintained by the use of legumes, manure, commercial fertilizer, or combinations of the three. The best method for maintaining nitrogen depends on the particular farm organization as well as on soil conditions.

Soil tests should be used as a guide to the quantity and kinds of fertilizer and lime that need to be applied. The Tennessee Agricultural Experiment Station has a soil-testing service that will analyze soil samples and give advice on fertilizer and liming. To get the most benefit from this service, soil samples must be collected properly. The county agricultural extension agent can advise on proper ways to collect soil samples for analysis and can also give advice on soil and crop management on the different soils and supply bulletins of the Experiment Station that will be helpful in the use and management of the soils.

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[6] Soil use refers to broad farm uses such as for (1) crops that require tillage; (2) permanent pasture; and (3) forest. Soil management refers to such practices as (1) choice and rotation of crops; (2) application of such soil amendments, as lime, commercial fertilizer, manure, and crop residues; (3) tillage practices; and (4) engineering practices for control of water on the land.

[7] Workability refers to ease of tillage, harvesting, and other field operations and is affected by texture, structure, consistence, stoniness, and degree of slope.

[8] Conservability refers to ease of maintaining or improving the productivity and workability of a soil.

[9] Productivity refers to the capacity of a soil to produce crops and pasture plants. This capacity is dependent not only upon the proper supply of nutrients but also upon such air and water relations as will make possible the efficient use of available nutrients by plants.

MANAGEMENT GROUP 1—NEARLY LEVEL WELL-DRAINED AND IMPERFECTLY DRAINED SOILS OF THE BOTTOM LANDS

Management group 1 includes good to excellent crop and pasture soils. They are well suited to intensive use for crop production, but their use is limited by susceptibility to periodic flooding, and, in some cases, by imperfect drainage. All the soils, except perhaps the Buncombe, are relatively fertile and produce comparatively high yields of suitable crops without the use of amendments. They are well supplied with lime, organic matter, and plant nutrients and are replenished periodically by additions of fresh sediments. Moisture conditions are favorable for the growth of plants most of the time. Practically all have a favorable tilth, which is easily maintained in good condition.

These soils are very well suited to corn and the summer-annual hay crops. They are poorly suited to alfalfa, although it is grown successfully in places, and better suited to red clover than alfalfa. Small grains are generally more susceptible to lodging and disease and normally mature later than on upland soils. Tobacco also is poorly suited, but cabbage, green beans, and many vegetable crops usually do well.

The soils of management group 1 and their workability, conservability, productivity, and use class [10] are given in table 4.

TABLE 4.—*Workability, conservability, productivity, and use class of the soils of management group 1, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Buncombe loamy fine sand.	Good	Very good	Medium	3
Chewacla fine sandy loam.	do	Good	High	2
Chewacla gravelly fine sandy loam.	Fair	do	do	3
Congaree fine sandy loam	Very good	Excellent	do	2
Congaree loam	do	do	Very high	1
Hamblen loam	do	Good	High	2
Lindside silt loam	Good	do	do	2
Ooltewah silt loam	do	do	do	2
Staser fine sandy loam	Excellent	Excellent	do	2

Management requirements.—Selection of suitable crops is very important for soils of management group 1. Crops can be successfully grown almost continuously, but a short rotation is desirable on most farms. A corn-hay rotation should be especially well suited, and also a corn-wheat-red clover rotation. Winter legumes, as crimson clover, plowed under in spring for green manure should prove beneficial, especially where corn is grown every summer. Cabbage, green beans, or other vegetable crops could be substituted for corn in the suggested rotations.

Except on Buncombe loamy fine sand, crop yields are good without

[10] See the section on Use Classes for a discussion of the five classes of soils.

amendments, but most of the soils respond very well to fertilization. Some fertilizer is required to maintain high yields under intensive use. Lime and phosphate are generally needed to establish and maintain red clover. Liberal quantities of phosphate will bring good response from practically all crops, and moderate applications of potash may be needed for some crops, the need depending on the crop grown and the previous cropping system. Nitrogen fertilizer may be needed if cropping is continuous, but a legume in the rotation generally supplies enough nitrogen for high crop yields.

Special tillage or cropping practices for maintaining tilth and controlling runoff are not generally necessary, for good tilth is easily maintained. In Chewacla gravelly fine sandy loam, however, gravel materially interferes with tillage. The soils are not ordinarily susceptible to erosion, but it may be necessary to build up stream banks in places to prevent scouring by floodwaters. The use suitability and general productivity of the imperfectly drained soils probably could be increased by artificial drainage; however, the advisability of drainage and the kind of drains to use on any particular area depend on many factors, including cost, feasibility of drainage from an engineering standpoint, and the kinds and extent of other soils on the farm.

Although very well suited to pasture, these soils are so well suited to more intensive use that use for pasture is largely precluded. Since they generally remain moist and productive throughout hot dry periods, they are especially valuable for pasture in certain areas. When they are used for pasture, management is concerned chiefly with supplying amendments, mainly lime and phosphate, to suitable pasture plants. Other requirements are proper control of grazing and scattering of droppings. Weed control is not a serious problem on pasture adequately fertilized and properly grazed, but mowing of excess herbage and undesirable plants may be necessary.

MANAGEMENT GROUP 2—UNDULATING NONSTONY SOILS OF THE YOUNG COLLUVIAL LANDS

Management group 2 consists of good to excellent crop and pasture soils, which are suited to intensive use for crop production and well suited to practically all the common crops grown in the county. They are not ordinarily susceptible to inundation by floodwater, and thus have a wider range in adaptation than soils of management group 1. All are deep, permeable, and well drained, with moisture conditions very favorable for growing plants. Content of organic matter and plant nutrients is moderately high to high, and water-holding capacity is high. Although not susceptible to flooding, these soils do receive some sediment from the adjacent slopes that tends to replenish plant nutrients and organic matter. Good tilth is easily maintained, and the soils can be tilled over a fairly wide range of moisture conditions without injury.

These soils are adapted to a large number of crops. They are well suited to corn and hay, very well suited to tobacco, but not especially well suited to small grain because it tends to lodge. Alfalfa is successfully grown, but it is better suited to upland soils, as the Decatur and Dunmore.

The soils of management group 2 and their workability, conservability, productivity, and use class are shown in table 5.

TABLE 5.—*Workability, conservability, productivity, and use class of the soils of management group 2, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Camp silt loam, undulating phase.	Very good	Excellent	High	2
Emory silt loam, undulating phase.	Excellent	do	Very high	1
Greendale silt loam, undulating phase.	do	do	High	2

Management requirements.—The soils of management group 2 are suited to intensive cropping. Yields are good under almost continuous use for row crops, but a short rotation is desirable on most farms. A rotation of corn, wheat, red clover, and tobacco is well suited. Almost any vegetable crop can be substituted for the corn or tobacco, and oats or barley for the wheat. Alfalfa can replace the red clover but will require a longer rotation. On some farms it may be necessary to use the soils of this group almost continuously for row crops; where this is done a tobacco-crimson clover rotation is advisable. Corn, potatoes, cabbage, or green beans may be substituted for the tobacco.

These soils are high in fertility, compared with others in the county, but they still give an excellent response when properly and adequately fertilized. Nitrogen is generally required, except where it is supplied by legumes. Phosphate is also generally needed for high yields of most crops. Potash is less likely to be deficient, but some crops may require it. Although none of the soils is especially low in lime, applications of lime benefit some crops, especially red clover, alfalfa, and similar legumes.

Tillage and water control ordinarily require no special attention. Control of runoff is a problem in only the few places where excess water runs from slopes above. Here there is danger of erosion and also of accumulation of heavy deposits washed from rapidly eroding slopes above. Diversion of runoff from eroding slopes may be desirable. Good tilth is easily maintained; tillage can be carried on over a fairly wide range of moisture conditions without seriously impairing the physical properties of the soils.

These soils are highly productive of pasture and are especially valuable because they stay moist and productive in hot dry periods. If used for pasture, phosphate is their chief requirement, although the Greendale and Camp soils probably will need lime. Other management requirements are control of grazing, scattering of droppings, and occasional mowing to remove excess herbage and undesirable plants.

MANAGEMENT GROUP 3—UNDULATING NONSTONY SOILS OF THE OLD COLLUVIAL AND TERRACE LANDS

The soils of management group 3 are good to excellent for crops and pasture. All are relatively high in fertility, easy to work and con-

serve, and productive of most of the crops commonly grown. They have mild slopes, are not seriously eroded, and are not very susceptible to erosion. As compared with upland soils, the content of organic matter and plant nutrients is moderate to high and moisture conditions are favorable for plant growth. The soils are not stony, and tilth conditions are very good to excellent.

These soils are well suited to practically all of the crops commonly grown in the area. They are especially well suited to vegetable crops, such as cabbage, green beans, and potatoes, and to tobacco. With proper fertilization and liming, alfalfa and red clover are successfully grown. These soils are not so well suited to corn as those of groups 1 and 2, although they are better suited than upland soils.

The workability, conservability, productivity, and use class of management group 3 soils are given in table 6.

TABLE 6.—*Workability, conservability, productivity, and use class of the soils of management group 3, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Allen loam, undulating phase.	Very good	Very good	Medium	2
Altavista silt loam	do	Good	do	2
Hayter loam, undulating phase.	Excellent	Very good	High	1
Hiwassee clay loam, eroded undulating phase.	Very good	do	do	1
Masada silt loam, undulating phase.	do	do	do	1
Sequatchie loam	Excellent	do	do	2
State loam	do	do	do	1
Tusquitee loam, undulating phase.	do	do	Very high	1

Management requirements.—The soils of management group 3 are suited to fairly intensive cropping. When other management requirements are met and legumes are included in the rotation, they can be conserved and their productivity maintained or increased even though a row crop is grown every third year. Winter cover crops and green-manure crops conserve soil moisture, improve tilth, and supply nitrogen and humus. Deep-rooted legume crops, as alfalfa and red clover, are well suited. A good rotation is corn, small grain, and then red clover and grass. Tobacco or any truck crop can be substituted for the corn. An intertilled crop, followed by a small grain and lespedeza, is also well suited.

These soils are generally slightly to moderately deficient in lime, phosphorus, nitrogen, and possibly potash for high yields of most of the crops commonly grown. Nevertheless, on most of these soils crops make excellent response to fertilization. Moderate applications of lime and phosphate are necessary for the successful growth of deep-rooted legumes, as alfalfa and red clover, and greatly increase yields of other legume crops, especially lespedeza. Nitrogen is required for high yields of practically all crops except legumes and the crops immediately following. Most crops respond well to phosphate. The

Sequatchie and Allen soils are likely deficient in potash for many crops, especially deep-rooted legumes, but the other soils of the group are adequately supplied. Heavy applications of a complete high-grade fertilizer are desirable for vegetable crops, tobacco, or potatoes. Properly conserved manure is an excellent source of both nitrogen and potash, but it should be supplemented with phosphate to obtain a balance of plant nutrients.

Good tilth is easily maintained, and tillage can be carried on over a fairly wide range of moisture conditions without seriously impairing the physical properties of these soils. Some gravel and cobblestones are on most areas, but not in sufficient quantities to interfere materially with tillage. Erosion control and soil-moisture conservation are not serious problems when crops are properly chosen and amendments are adequate. Engineering devices for controlling erosion are not generally needed, but contour tillage is desirable wherever feasible.

These soils are well suited to pasture. Good pasture is generally obtained without special preparation other than seeding, but moderate applications of lime and phosphate are necessary to obtain high yields of good quality. Properly controlled grazing and fertilization usually control weeds, but mowing may be necessary.

Although these soils are generally less highly leached than the associated upland soils, they are moderately deficient in lime, phosphorus, nitrogen, and possibly potash. Applications of lime and phosphate are essential for the successful growth of alfalfa or red clover, and practically all crops make an excellent response to phosphorus. Nitrogen is deficient for all except legume crops and the crops immediately following. Potash, except on the Jefferson and Sequatchie soils, is not likely to be deficient except for such crops as alfalfa and potatoes. Barnyard manure is an excellent source of nitrogen, potash, and organic matter for all crops.

The large quantity of stones, gravel, or cobbles in these soils interferes with tillage. In some places, it may be practical to remove the largest loose stones and thus improve workability. Although susceptibility to erosion is very slight in most places, tillage should be on the contour wherever feasible.

These are fair to good pasture soils. They produce very good early pasture, but pasture is generally poor late in summer and early in fall. A pasture mixture that includes bluegrass, orchard grass, redtop, white clover, red clover, hop clover, and lespedeza is well suited. Management is concerned chiefly with supplying lime and phosphorus to properly selected pasture mixtures, controlling grazing, scattering droppings, and mowing to remove excess herbage and weeds.

MANAGEMENT GROUP 4—UNDULATING STONY SOILS OF THE COLLUVIAL AND TERRACE LANDS AND COBBLY ALLUVIUM

The soils of management group 4 are characterized by many stones, pieces of gravel, or cobbles on the surface and throughout the profile. The cobbly alluvium contains almost enough cobbles to prohibit tillage. These soils are suited to fairly intensive use for crop production, but the stones materially interfere with tillage. They are deep very permeable soils moderately high to low in water-holding

capacity. Reaction is medium to strongly acid, and content of organic matter and plant nutrients is high to moderate. Slopes are mild, and erosion susceptibility is only slight. These soils differ from those of management group 3 chiefly in being stony and more difficult to till. They further differ in being less fertile generally and in having moisture conditions much less favorable for plant growth.

Most of the common crops of the county are fairly well suited, but their suitability is somewhat limited by stoniness and droughtiness of the soils. Early vegetable crops are well suited, and crops such as crimson clover, red clover, and small grains are fairly well suited. Crops that mature late in summer or early in fall are not so well suited.

Soils of management group 4 and their workability, conservability, productivity, and use class are given in table 7.

TABLE 7.—*Workability, conservability, productivity, and use class of the soils of management group 4, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Cobbly alluvium (Hamblen soil material).	Very poor	Good	Low	4
Hayter stony loam, undulating phase.	Good	Very good	High	2
Jefferson gravelly loam, eroded undulating phase.	do	Good	Low	3
Jefferson stony fine sandy loam, undulating phase.	do	do	do	3
Masada gravelly silt loam, undulating phase.	do	Very good	High	2
Sequatchie gravelly loam	do	do	do	3

Management requirements.—Although management group 4 soils are suited to fairly intensive use for crops, crop rotation and fertilization are required to maintain or increase yields. The rotation can be moderately short, but it should include a legume. A rotation consisting of corn, wheat, and red clover or red clover and grass is suitable. Any row crop can be substituted for the corn, and any small grain for the wheat.

MANAGEMENT GROUP 5—ROLLING NONSTONY YOUNG COLLUVIAL SOILS

The soils of management group 5 are good to excellent for crops and pasture. They differ from those of group 2 chiefly in having steeper slopes of 7 to 15 percent. As a group, they are well suited to intensive use for practically all the common crops of the county. All are deep permeable well-drained soils with moisture conditions very favorable for growing plants. Content of organic matter and plant nutrients is moderately high to high, and water-holding capacity is high. Although not ordinarily susceptible to stream flooding, these soils receive some sediments from the adjacent slopes, which replenish

the content of plant nutrients and organic matter. The soils are easily worked and conserved.

These soils have a wide range in use suitability. They are well suited to corn and hay crops, very well suited to tobacco and vegetable crops, but not especially well suited to small-grain crops, which tend to lodge in many places. Alfalfa is successfully grown, but it is probably better suited to upland soils such as the Decatur and Dunmore.

Management group 5 soils and their workability, conservability, productivity, and use class are given in table 8.

TABLE 8.—*Workability, conservability, productivity, and use class of the soils of management group 5, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Camp silt loam, rolling phase.	Good	Very good	High	2
Emory silt loam, rolling phase.	Very good	do	Very high	1
Greendale silt loam, rolling phase.	do	do	High	2

Management requirements.—Owing to the stronger slopes, soils of management group 5 cannot be used so intensively as those of group 2. To maintain crop yields at comparable levels, a longer rotation is required. A rotation of corn, small grain, and red clover or of red clover, grass, and tobacco or a vegetable crop is well suited. Row crops can be grown almost continuously if adequately fertilized and if a winter cover crop, such as crimson clover, follows each row crop.

Although their fertility is comparatively high, these soils respond very well when properly and adequately fertilized. In most areas, lime and phosphate are needed for success in growing red clover or alfalfa. Nitrogen is needed for continued high yields, except where supplied by legumes. Phosphate is also generally required for high yields of most crops. Potash is less likely to be deficient, but some crops may require it. Heavy applications of a high-grade complete fertilizer are desirable for tobacco and truck crops in most places.

Good tilth is easily maintained. The soils can be tilled over a wide range of moisture conditions without injury to their physical properties. The control of runoff is not a serious problem, but excess runoff from the upland slopes should be diverted. In some places, the soils are somewhat susceptible to loss of material through erosion; whereas in others they are injured by deposits of material washed from severely eroded upland slopes. If feasible, contour tillage is advisable.

These soils are highly productive of pasture and especially valuable because they remain moist and productive throughout hot dry periods. If they are used for pasture, phosphate is the chief requirement, but lime may be needed on the Camp and Greendale soils. Other manage-

ment practices include proper control of grazing, scattering of droppings, and an occasional mowing.

MANAGEMENT GROUP 6—ROLLING NONSTONY SOILS OF THE OLD COLLUVIAL AND TERRACE LANDS

The soils of management group 6 are poor to good cropland and fair to very good pasture land. They are moderately easy to work and conserve but vary considerably in productivity. All are deep friable well-drained soils with slopes ranging from 5 to 15 percent. They are very permeable to air, roots, and water. Rainfall is readily absorbed and well retained. Water-holding capacity is moderate to moderately high, and content of plant nutrients ranges from low to high. Stones in the plow layer are not sufficient to interfere with tillage, although some cobblestones or gravel can be expected.

These soils are suited to a wide variety of crops, including corn, wheat, oats, barley, tobacco, and many vegetables. If properly fertilized, such crops as red clover and alfalfa are successfully grown.

The workability, conservability, productivity, and use class of the soils of management group 6 are given in table 9.

TABLE 9.—*Workability, conservability, productivity, and use class of the soils of management group 6, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Allen loam:				
Eroded rolling phase	Good	Good	Medium	3
Rolling phase	do	do	do	2
Hayter loam, rolling phase	Very good	do	High	2
Hiwassee clay loam, eroded rolling phase.	Good	do	do	2
Holston fine sandy loam, eroded rolling phase.	Very good	Poor	Low	3
Jefferson fine sandy loam, eroded rolling phase.	do	Fair	do	3
Leadvale silt loam	do	do	Medium	3
Masada silt loam, eroded rolling phase.	Good	Good	do	2
Nolichucky fine sandy loam, eroded rolling phase.	Very good	do	do	3
Tate loam, rolling phase	do	do	High	3
Tusquitee loam, rolling phase	do	do	Very high	2

Management requirements.—The soils of group 6 are much more exacting in their management requirements than those of groups 1, 2, 3, 4, or 5. Longer rotations and heavier fertilization as well as better water-control measures are required. If other management practices are good, the soils can be maintained in a 4- to 6-year rotation. A rotation of corn, small grain, clover and orchard grass (3 years), tobacco, and crimson clover is well suited. Most any other row crop commonly

grown can be substituted for either corn or tobacco. Alfalfa could replace the red clover if the rotation were lengthened. A cover crop should follow all intertilled crops.

These soils are deficient in lime, phosphorus, and nitrogen for high yields of most crops. They vary considerably in the degree of deficiency. The Nolichucky, Allen, Holston, Jefferson, and Leadvale soils are much more deficient than the other members, and they (especially the Allen, Jefferson, and Holston) are also likely to be highly deficient in potash (pl. 8, *A*). The legume crops, particularly deep-rooted ones, require lime, potash, and phosphorus; but if they are inoculated, nitrogen is not needed. An inoculated legume crop generally supplies an adequate quantity of nitrogen for other crops in a rotation, especially if turned under. All crops respond well to applications of phosphorus, and a complete fertilizer is needed for truck crops and tobacco. Properly conserved manure is a good source of nitrogen and potash, but it should be supplemented with a phosphate fertilizer to obtain a balance of plant nutrients.

Good tilth is easily maintained, and tillage operations can be carried on over a fairly wide range of moisture conditions. All of these soils are somewhat stony, but stoniness does not materially interfere with their tillage. Susceptibility to erosion is moderate, but runoff and erosion control are not serious problems if other management practices are good. Contour tillage should be practiced wherever feasible, however, and contour strip cropping may be advisable on the long slopes. Terraces or other engineering devices for runoff control should not be necessary unless a shorter rotation than that already suggested is to be used. These deep permeable soils generally have regular slopes and should be well suited to terraces if suitable outlets are available.

This group of soils is physically well suited to pasture. Pasture management is concerned chiefly with supplying amendments, mostly lime and phosphate, to suitable pasture plants. Other requirements include proper control of grazing and scattering of droppings. Weed control is not a serious problem on pasture that receives adequate amendments and is properly grazed, but an occasional mowing may be necessary.

MANAGEMENT GROUP 7—ROLLING STONY SOILS OF THE COLLUVIAL AND TERRACE LANDS

The soils of management group 7 differ from those of group 4 chiefly in having steeper slopes (7 to 15 percent). Stone, cobbles, or gravel on the surface and in the plow layer interfere with and, in a few places, almost prohibit tillage. These are deep very permeable well-drained soils having moderate to low water-holding capacity, medium to strongly acid reaction, and a varying but usually moderate to low content of plant nutrients and organic matter.

The soils are suited to a wide variety of crops and pasture, but most of them are difficult to work and conserve. Productivity varies, but it is generally low.

Soils of management group 7 and their workability, conservability, productivity, and use class are given in table 10.

TABLE 10.—*Workability, conservability, productivity, and use class of the soils of management group 7, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Allen stony loam, eroded rolling phase.	Fair	Good	Medium	3
Camp stony silt loam, rolling phase.	do	Very good	High	3
Hayter stony loam, rolling phase.	do	Good	do	3
Holston cobbly fine sandy loam, eroded rolling phase.	do	Fair	Low	3
Jefferson gravelly loam:				
Eroded rolling phase	do	do	do	3
Rolling phase	do	do	do	3
Jefferson stony fine sandy loam:				
Eroded rolling phase	do	do	do	3
Rolling phase	do	do	do	3
Masada gravelly silt loam, eroded rolling phase.	do	Good	Medium	3
Tusquitee stony loam, rolling phase.	do	do	Very high	3

Management requirements.—Group 7 soils are suited to crops, but owing to difficulty of tillage, it may be desirable to use them largely for pasture on many farms. Many farmers favor a long rotation such as corn-wheat-pasture (3 to 5 years). If more intensive use is necessary, a rotation of corn-small grain or corn-red clover and grass (3 years) is suitable. Any commonly grown row crop can be substituted for the corn.

In practically all of these soils supplies of lime, phosphorus, and nitrogen are too low for high yields of most crops. The Allen, Jefferson, and Holston soils are likely to be also deficient in potash. For some of the soils, applications of lime, phosphate, and potash are essential to successful growth of alfalfa and red clover. Practically all crops respond very well to phosphate. Nitrogen is essential for high yields of all except possibly the legume crops. Potash is not so likely to be a limiting nutrient, except for such crops as alfalfa and potatoes. Barnyard manure is an excellent source of nitrogen, potash, and organic matter.

These soils are susceptible to erosion; tillage should be on the contour where feasible. Engineering devices for controlling water should not be necessary if enough fertilizer is applied and a crop rotation similar to those suggested is used. Removing the loose stones would improve workability, but usually this is practical for only the small areas.

The soils of this group are fair to good for pasture. To establish and maintain high yielding pasture of good quality, however, moderate to heavy applications of lime and phosphate are required. A pasture mixture that includes bluegrass, orchard grass, redtop, white clover, hop clover, and lespedeza is well suited. Other management practices are properly controlling grazing, scattering of droppings, and mowing to remove excess herbage and weeds.

MANAGEMENT GROUP 8—ROLLING RED PLASTIC SOILS FROM HIGH-GRADE LIMESTONE

Management group 8 includes heavy red soils of the uplands developed from the residuum of relatively high-grade limestone. Bedrock is generally at 5 feet or more. All are well-drained medium to strongly acid soils with firm moderately plastic subsoils. They are susceptible to erosion, and most areas have lost a part of the surface soil. Compared with other cropped soils of the uplands, they are relatively high in organic matter, plant nutrients, and water-holding capacity. Content of organic matter and plant nutrients, especially nitrogen, depends largely on the past cropping system and loss of soil material by accelerated erosion.

These soils are physically well suited to practically all of the crops commonly grown. They are very well suited to most hay crops, especially alfalfa, but they are not so well suited to corn, tobacco, and truck crops as the soils of group 2.

Soils of management group 8 are listed with their workability, conservability, productivity, and use class in table 11.

TABLE 11.—*Workability, conservability, productivity, and use class of the soils of management group 8, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Decatur silty clay loam, eroded rolling phase.	Good	Fair	High	1
Dunmore silty clay loam, eroded rolling phase.	do	do	Medium	2

Management requirements.—The soils of management group 8 vary widely in their adaptability to various kinds of crops, but selection of suitable crops is not difficult. If productivity is to be maintained or increased, it is important that the crops selected be grown in proper rotation. Row crops need to be alternated with close-growing ones, and the periodic use of deep-rooted crops is beneficial. The rotation, however, can be of moderate length. Observations indicate that a row crop can be safely grown once every 3 or 4 years if fertilization and other management practices are good. A rotation of corn, small grain, and alfalfa for 4 years is well suited. A winter cover crop should follow all clean-cultivated crops. Grass should be grown periodically to maintain the supply of organic matter. If a grass is not included in the rotation, green manuring should be practiced.

Fertilization and liming are of great importance on these soils if medium to high yields are to continue. Lime and phosphate are needed, especially for legumes and grasses; deep-rooted legumes normally need some potash. Nitrogen is a general requirement unless it is supplied by legumes.

Eroded areas can be tilled over only a limited range of moisture conditions, but good tilth is easily maintained on the uneroded soils. Grasses and green-manure crops tend to improve tilth conditions. Fall plowing for improvement of tilth is considered a good practice if a cover can be established that will prevent excessive runoff and con-

sequent loss of soil material. Contour tillage aids materially in conserving soil moisture and soil material.

Terracing of the heavy soils is generally not advisable; strip cropping may be advisable on the longer slopes. Special engineering devices for water control should not be necessary if management is otherwise good.

These soils are very well suited to pasture, but, because of their less favorable moisture supply, are not so well suited as soils of groups 1 or 2. Good pasture can be established without amendments, but the response to lime and phosphate is excellent. Pasture is somewhat difficult to establish on the more severely eroded spots, but applications of barnyard manure and nitrogen fertilizer will aid greatly. After pasture is established, legumes in the pasture mixture should supply most of the nitrogen needed for high yields. Other management practices include scattering of droppings, clipping to control undesirable plant growth, and control of grazing.

MANAGEMENT GROUP 9—ROLLING YELLOWISH-RED AND YELLOW FRIABLE SOILS FROM DOLOMITIC LIMESTONE

The soils of management group 9 are fair to good for crops and pasture. They are generally somewhat lower in natural fertility than the soils of group 8 but they are lighter, more friable, and less susceptible to erosion. The content of essential plant nutrients and organic matter is low. They have 7- to 15-percent slopes and are moderately eroded. They absorb and retain moisture well and are sufficiently permeable to permit free circulation of air and moisture. Because the water-holding capacity of the Clarksville and Groseclose soils is lower than that of the Fullerton soils, crops on them are injured more by droughts. Although some chert is on the surface and in the plow layer of all these soils, only the Clarksville soil contains sufficient chert to interfere materially with tillage.

These soils are fairly well suited to all the crops commonly grown in the county. Yields are moderate to low, owing chiefly to deficiencies in plant nutrients and poor moisture relations. These soils are responsive to good management, however. With adequate liming and fertilization, alfalfa and red clover can be grown, but not nearly so successfully as on group 8 soils.

The workability, conservability, productivity, and use class of the soils of management group 9 are shown in table 12.

TABLE 12.—*Workability, conservability, productivity, and use class of the soils of management group 9, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Clarksville cherty silt loam, eroded rolling phase.	Fair	Fair	Low	3
Fullerton loam, eroded rolling phase.	Very good	Good	Medium	3
Fullerton silt loam, eroded rolling phase.	Good	do	do	3
Groseclose silt loam, eroded rolling phase.	do	Fair	do	3

Management requirements.—Soils of management group 9 are moderately low in natural fertility but are suitable for moderately intensive use, chiefly because they have favorable physical properties and respond to good management. Rotation of crops and fertilization are required to maintain or increase crop yields. The soils can be conserved under a rotation that includes a row crop once every 3 or 4 years. A useful rotation is a row crop the first year, small grain seeded in the row crop the second year, and a legume or legume-grass mixture for 3 years. Legumes and green-manure crops should have an important place in the cropping system inasmuch as they are effective in maintaining or increasing supplies of organic matter and nitrogen, conserving moisture, and preventing erosion.

These soils are deficient in lime, nitrogen, phosphorus, and possibly potash for high yields of most crops. Wherever barnyard manure is available, it should be applied liberally as a source of nitrogen, potash, and humus and as a means of improving tilth and increasing moisture-holding capacity. Some phosphate fertilizer should be used with manure to obtain a correct balance of plant nutrients. Where manure is not available or is available in only small quantities, corn, small grain, tobacco, vegetables, and grasses need complete commercial fertilizer. Legumes and legume-grass mixtures require phosphorus and possibly potash but need no nitrogen if properly inoculated. Lime is necessary to insure success with legumes, especially deep-rooted ones. Fertilizer should be used in quantities adequate for the needs of the particular crop to which they are applied rather than in large quantities at infrequent intervals.

Good tilth is easily maintained, and tillage can be carried on over a wide range of moisture conditions without injuring the soils. Where crops are properly selected and rotated and receive adequate fertilizer and lime, runoff and erosion are greatly reduced and few special practices for water control are needed. Tillage, however, should be on the contour if feasible. On the longer slopes strip cropping may be useful in some places, but the strips must be carefully planned and managed to be effective.

The soils of this group are well suited to pasture. A pasture mixture that includes bluegrass, orchard grass, redtop, white clover, hop clover, red clover, and lespedeza is suited. Phosphorus and lime are needed in moderate quantities at frequent intervals to maintain highly productive pasture. Initial pasture seedings may need a potash fertilizer as well, but, subsequently, scattered droppings should maintain an adequate supply. Control of grazing is important, especially during the drier summer and early fall months when overgrazing may injure the pasture stand. Occasional mowing may be needed to remove excess herbage and to control weeds.

MANAGEMENT GROUP 10—ROLLING SHALLOW SHALY SOILS CHIEFLY FROM CALCAREOUS SHALE

Soils of management group 10 are fair for crops and good for pasture. They are physically suitable for crops that require tillage, but their location makes such use impractical on most farms. In general, they are on narrow winding ridge tops in a hilly to steep landscape that is largely surrounded by very shallow soils. The soils

of this group are moderately well supplied with lime and potash, but they are generally low in phosphorus and nitrogen. They are susceptible to erosion, and most areas are moderately eroded at present. A considerable part of the original surface soil has been lost, including the surface layer of higher organic-matter content. The water-holding capacity is relatively low.

These soils are probably best suited to pasture, but they are fairly well suited to small grain, tobacco, red clover, and alfalfa. They are generally poorly suited to crops, such as corn, that mature in the drier summer and early fall months.

Group 10 soils and their workability, conservability, productivity, and use class are given in table 13.

TABLE 13.—*Workability, conservability, productivity, and use class of the soils of management group 10, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Dandridge shaly silt loam, eroded rolling phase.	Good	Fair	Medium	3
Teas-Litz silty clay loams, eroded rolling phases.	do	do	Low	3

Management requirements.—On group 10 soils productivity generally cannot be maintained under very intensive usage. A moderately long rotation that consists chiefly of close-growing crops is desirable in most places. A rotation of wheat, red clover and grass (3 years), and tobacco or corn is suitable. Pasturing the grass for 1 or 2 years to lengthen the rotation is considered a good practice. Lespedeza can be sown with the grass as the red clover disappears.

The soils are generally very deficient in phosphate and nitrogen for high yields of most crops, but lime and potash are not needed in many places except for the most exacting crops. Tests should be made before either lime or potash is applied. A very good response is usually obtained from phosphate, especially on small grains or pasture. Nitrogen is needed for all except the legume crops or the crops immediately following.

Numerous small shale fragments are on the surface and throughout the profiles of these soils, but they do not interfere materially with tillage. The soils are susceptible to great injury from erosion, but adequate fertilization, suitable rotations, and contour tillage should control erosion. These soils are not considered physically suited to terraces, but if they were, the lack of suitable outlets would largely preclude their use.

These soils are well suited to and largely used for pasture. Management is chiefly concerned with supplying adequate quantities of phosphate, control of grazing to prevent damage to the pasture stand, and control of weeds. A pasture mixture that includes bluegrass, orchard grass, redtop, white clover, red clover, hop clover, and lespedeza is suitable. Owing to the low water-holding capacity, pasture is likely to be short during the drier summer and early fall months.

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MANAGEMENT GROUP 11—ROLLING MODERATELY DEEP NONSTONY FRIABLE SOILS FROM GRANITE AND QUARTZITE

Management group 11 includes well-drained moderately deep soils of mountain crests or plateaus that are physically suitable for production of either crops or pasture. These soils are strongly acid, moderately well supplied with organic matter, and low to high in natural fertility. They are fairly easy to work, although many areas are small and irregular in shape and some are relatively inaccessible.

Owing to favorable physical characteristics and climatic conditions, these soils are very well suited to vegetable crops, such as beans or cabbage, and to potatoes and buckwheat. They are apparently not very well suited to small grains but are very well suited to most clovers and grasses.

Workability, conservability, productivity, and use class of the soils of management group 11 are shown in table 14.

TABLE 14.—*Workability, conservability, productivity, and use class of the soils of management group 11, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Balfour loam, rolling phase	Very good	Good	High	2
Matney loam, rolling phase	do	Fair	Low	3
Perkinsville loam:				
Eroded rolling phase	Good	Good	Medium	3
Rolling phase	Very good	do	do	3

Management requirements.—The scarcity of cropland in the areas in which group 11 soils occur may force the farmers to use the soils intensively for crop production. The soils are generally not considered suitable for very intensive use except under a very high management level. To maintain or increase crop yields requires proper application of amendments and choice and rotation of crops. A rotation of moderate length, including legumes and grasses, is adequate in most areas. A rotation of beans, red clover, and orchard grass (3 years), corn, and crimson clover is well suited. Burley tobacco, cabbage, buckwheat, or potatoes can be substituted for either the corn or beans, or both, in this rotation. Winter cover crops should follow all intertilled crops. Owing to more favorable moisture conditions, they are more easily established early in fall than on soils in the valley part of the county.

These soils are deficient in lime, phosphate, and nitrogen for high yields of most crops, but they vary greatly from place to place and from one soil to another in degree of deficiency. Nitrogen is required for high yields of all except legume crops and crops immediately following. Lime and phosphate are needed for success with most legumes, and all crops respond well to applications of phosphate fertilizer. Potash is not generally needed on Balfour and Perkinsville soils, except for potatoes and other exacting crops. The Matney soil, however, may be very deficient in potash.

Good tilth is very easily maintained, and the soils can be worked over a wide range of moisture conditions without injury. They are moderately susceptible to erosion when not properly protected by a

vegetative cover. If proper fertilization and a rotation similar to that suggested is used, however, water control should not be a serious problem. All tillage should be as nearly on the contour as possible, and cover crops should follow all intertilled crops if at all feasible. Strip cropping may be desirable on the longer slopes. Narrow strips of intertilled crops approximately on the contour should alternate with strips of close-growing crops or meadow. The soils are physically suited to and the slope range is favorable for the use of terraces, but they are not likely to be needed unless the soil is used much more intensively than suggested.

These soils are very well suited to pasture. They are not naturally highly productive of pasture plants, but good pasture can be established and maintained with proper and adequate fertilization and liming. Moisture conditions are very favorable during summer and fall when pasture on the valley soils is generally short because of drought. Lime and phosphorus are the chief amendments required, but nitrogen may be needed to establish pasture or where the proportion of legumes in the pasture stand is low. Properly controlled grazing and fertilization will control weeds in most places, but some clipping may be necessary.

MANAGEMENT GROUP 12—HILLY NONSTONY SOILS OF THE COLLUVIAL AND TERRACE LANDS

The soils of group 12 differ from those of group 6 chiefly in having stronger slopes of 15 to 30 percent. They make fair cropland and fair to very good pasture land. The stronger slopes increase the difficulty of tilling and conserving; therefore a higher level of management is required to maintain these soils than those of group 6. They are deep very permeable well-drained soils that vary greatly in content of organic matter and plant nutrients. Water is readily absorbed and well retained. None contains sufficient stones to interfere materially with tillage, although some cobblestones or gravel are in all.

These soils are well suited to a wide variety of crops, including corn, wheat, oats, barley, tobacco, and many vegetable crops. If properly fertilized, crops such as alfalfa and red clover grow successfully. Exacting conservation requirements, however, greatly limit the choice of crops and frequency with which they can be grown.

Soils of management group 12 and their workability, conservability, productivity, and use class are given in table 15.

TABLE 15.—*Workability, conservability, productivity, and use class of the soils of management group 12, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Camp silt loam, hilly phase	Good	Good	Medium	3
Hiwassee clay loam, eroded hilly phase.	Fair	Fair	High	3
Nolichucky fine sandy loam, eroded hilly phase.	Good	do	Low	3
Tate loam, hilly phase	do	do	High	3
Tusquitee loam, eroded hilly phase	do	do	do	3

Management requirements.—Most of group 12 soils are exacting in their management requirements—good tillage practices, proper and adequate fertilization, and a long rotation that consists chiefly of close-growing crops are needed. A corn, small grain, red clover and orchard grass (4 years) rotation is suitable for most areas. A rotation of barley or other small grain and red clover and orchard grass (3 years) would give greater protection from erosion. A rotation of a small-grain crop seeded in contour furrows, followed by lespedeza, is successfully used by a few farmers.

Supplies of lime, phosphorus, and nitrogen are too low for continued high yields of most crops, but the soils vary considerably in degree of deficiency. The Nolichucky soils are more deficient in these elements, than the rest, and also deficient in potash for most crops. Legume crops, especially deep-rooted ones, require lime and phosphorus, but if inoculated, do not need nitrogen. Deep-rooted crops, as well as such crops as potatoes, may require potash. All crops respond well to phosphate fertilizer; truck crops and tobacco require heavy applications of complete fertilizer.

Good tilth is easily maintained; the soils can be tilled over a wide range of moisture conditions. Surface runoff and loss of soil material through erosion are difficult to control but can be minimized by using long rotations consisting chiefly of close-growing crops and by tilling entirely on the contour. Contour strip cropping may be advisable on the longer slopes.

These soils are physically well suited to pasture, and on many farms are probably best used for that purpose. Management is concerned mainly with supplying amendments, chiefly lime and phosphate, to suitable pasture plants. Grazing should be controlled so as to maintain a good sod at all times. Weed control is not a serious problem on pastures that are adequately limed and fertilized and properly grazed, but an occasional clipping may be necessary.

MANAGEMENT GROUP 13—HILLY PLASTIC RED SOILS FROM HIGH-GRADE LIMESTONE (NOT SEVERELY ERODED)

Group 13 includes heavy red soils of the uplands developed from the residuum of relatively high-grade limestone. They differ from the soils of group 8 chiefly in having steeper slopes of 15 to 30 percent. All are well-drained, generally 5 feet or more in depth, medium to strongly acid, and have firm moderately plastic subsoils. The present content of organic matter and plant nutrients depends largely on the past cropping system and loss of material by accelerated erosion, but in general it is relatively high. Water-holding capacity is moderate to high.

These soils are physically well suited to practically all of the crops commonly grown in the county. They are very well suited to alfalfa, most of the other hay crops, and pasture, but they are not so well suited to corn, tobacco, and truck crops. The exacting management requirements greatly limit the choice of crops and frequency with which they can be grown.

The workability, conservability, productivity, and use class of the soils of management group 13 are given in table 16.

TABLE 16.—*Workability, conservability, productivity, and use class of the soils of management group 13, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Decatur silty clay loam, eroded hilly phase.	Fair	Poor	High	3
Dunmore silt loam, hilly phase	do	do	do	3
Dunmore silty clay loam, eroded hilly phase.	do	do	Medium	3

Management requirements.—The management requirements of group 13 soils are much more exacting than those of group 8, chiefly because of stronger slope and greater susceptibility to erosion. This group requires longer rotations and more careful tillage, but fertilization and liming requirements are similar. A rotation of corn followed by alfalfa and orchard grass (4 or 5 years) is suitable.

Tillage should be on the contour, but if this is impossible because of sinkholes or very irregular slopes, rotations should be longer and the row crops omitted. Where the slopes are long and regular, contour strip cropping should be considered.

These soils are well suited to pasture. Fair pasture can be established and maintained without applying amendments, but lime and phosphate bring a very good response. Pasture is somewhat difficult to establish on the more severely eroded spots, but establishment is aided greatly by applications of barnyard manure and nitrogen. After the pasture is established, legumes in the pasture mixture should supply most of the nitrogen needed for high yields. Other management practices include scattering droppings, clipping to control undesirable plant growth, and control of grazing to prevent injury to the stand.

MANAGEMENT GROUP 14—HILLY MODERATELY DEEP NONSTONY FRIABLE SOILS FROM QUARTZITE AND GRANITES

Group 14 includes well- to excessively drained soils of the mountain uplands. They are coarse-textured very permeable soils that are relatively well supplied with organic matter, but they vary greatly in content of plant nutrients. Water-holding capacity is only moderate, but owing to favorable rainfall distribution, moisture is seldom a limiting factor in crop production. The soils differ from those of group 11 chiefly in having steeper slopes of 15 to 30 percent.

Owing to favorable climatic conditions and physical characteristics, these soils are well suited to vegetable crops, such as beans and cabbage, potatoes, buckwheat, most clovers, and grasses. They are apparently not well suited to small grain crops. Their suitability for certain crops may vary considerably because of differences in altitude or topographic location.

The soils of management group 14 and their workability, conservability, productivity, and use class are given in table 17.

TABLE 17.—*Workability, conservability, productivity, and use class of the soils of management group 14, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Ashe sandy loam:				
Eroded hilly phase	Good	Fair	Medium	3
Hilly phase	do	do	do	3
Balfour loam, hilly phase	do	do	High	3
Perkinsville loam:				
Eroded hilly phase	do	do	Low	3
Hilly phase	do	do	Medium	3

Management requirements.—Owing to hilly relief and susceptibility to accelerated erosion, group 14 soils are poorly suited to intertilled crops. They are better suited to close-growing crops and pasture. The relief makes it difficult in many areas to use grain binders or other heavy types of machinery. Requirements for tillage and choice and rotation of crops are more exacting than those for the soils of management group 11, but the requirements for amendments are similar. A long rotation, 6 years or more, is desirable on most farms. A rotation of corn, small grain, and red clover and orchard grass (meadow or pasture 4 or 5 years) is suitable. Tobacco or any of the vegetable crops can be substituted for the corn.

These soils should be protected from accelerated erosion by keeping them under a plant cover as much of the time as feasible; tillage should be as nearly on the contour as possible. Strip cropping is desirable on long regular slopes. Narrow strips of intertilled crops should alternate with strips of legume-and-grass hay or other close-growing crops. Strips 40 to 60 feet wide are commonly used, but width will depend largely on the slope (pl. 9.).

Most clovers and grasses are suited, and with adequate applications of amendments, good pasture can be established and maintained. Moisture conditions are comparatively very favorable for pasture, especially during summer and fall. The grazing season is somewhat shorter than in the valley area, however. Lime and phosphorus are the chief amendments required, but nitrogen may be needed if the proportion of legumes in the pasture mixture is low. Properly controlled grazing and fertilization will control weeds in most places, but some clipping may be necessary.

MANAGEMENT GROUP 15—HILLY YELLOWISH-RED AND YELLOW SOILS FROM DOLOMITIC LIMESTONE

Soils of group 15 are poor to fair for crops and fair to good for pasture. They differ from the soils of group 9 chiefly in having steeper slopes with gradients of 15 to 30 percent. They are deep relatively permeable well-drained soils moderate to low in natural productivity. The content of organic matter and plant nutrients is moderate to low, and the water-holding capacity is low. The soils absorb water readily and are sufficiently permeable to permit free circulation of air and moisture and easy penetration of plant roots. Although some chert fragments are on the surface and throughout the soil pro-

file of all these soils, only the Clarksville soil is sufficiently cherty to interfere with tillage.

These soils are physically suited to a wide variety of crops, but exacting management requirements limit the choice of crops and the frequency with which they can be grown. Applications of amendments are necessary before some crops, such as alfalfa or red clover, can be successfully grown. Moisture conditions are not generally favorable for tobacco or vegetables.

Workability, conservability, productivity, and use class of the soils of management group 15 are shown in table 18.

TABLE 18.—*Workability, conservability, productivity, and use class of the soils of management group 15, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Clarksville cherty silt loam:				
Eroded hilly phase	Poor	Poor	Low	4
Hilly phase	do	do	do	4
Fullerton loam:				
Eroded hilly phase	Fair	Fair	Medium	3
Hilly phase	do	do	do	3
Fullerton silt loam:				
Eroded hilly phase	do	do	do	3
Hilly phase	do	do	do	3
Groseclose silt loam, eroded hilly phase.	do	Poor	do	4

Management requirements.—The management requirements for group 15 soils are very exacting for the successful growth of crops. On most farms these soils are probably best used for semipermanent hay crops or pasture. To maintain or increase productivity, a long rotation consisting chiefly of close-growing crops and proper and adequate fertilization are required. If other management practices are good, a row crop can probably be grown every 5 or 6 years. A cover crop, preferably a legume, should follow the intertilled crop. Where the soils are kept in sod crops most of the time, erosion is prevented, soil moisture is conserved, and supplies of nitrogen and humus are increased.

These soils, like those of group 9, are low in nitrogen, phosphorus, potash, and lime and require similar fertilization. Small grains and grass crops require complete fertilizer for high yields. Legumes or legume-grass mixtures need phosphorus and potash but no nitrogen if they are properly inoculated. Lime is necessary for good stands of legumes and improves the yield and quality of other crops in the rotation. As on other soils, barnyard manure applied in adequate quantities is an excellent source of nitrogen, potash, and organic matter. Amendments should be applied to meet the needs of a particular crop, rather than in large quantities at long intervals.

Tillage is moderately difficult because of the strong slopes, and in the case of the Clarksville soils, because of chertiness. Good tilth is fairly easily maintained; tillage can be carried on over a fairly wide range of moisture conditions. Erosion control and moisture conservation can be attained largely through correct choice, rotation, and fertilization of crops, but other special practices are needed in some places.

All tillage should be on the contour, and where it is necessary to grow row crops, some system of strip cropping is advisable (pl. 7, *B*). In general, terraces are not feasible on these strongly sloping soils.

These soils are suited to pasture but less well suited than those of group 9. Management requirements, however, are very similar and are concerned chiefly with supplying needed amendments to suitable pasture mixtures, controlling grazing, and eradicating weeds.

MANAGEMENT GROUP 16—NEARLY LEVEL POORLY DRAINED SOILS OF THE STREAM BOTTOMS AND TERRACES

Group 16 soils are poorly suited to crops but fair to good for pasture. They are poorly drained and occupy nearly level to slightly depressed areas. The Wehadkee soil is on stream bottoms that are subject to flooding, and the Roanoke soil is on stream terraces. The Roanoke is low in fertility and strongly to very strongly acid; the Wehadkee varies considerably both in fertility and reaction.

Under natural drainage conditions, these soils are considered poorly suited to the production of crops requiring tillage. They are considered suitable for pasture, although the Roanoke soil is low in productivity of pasture plants. These soils would be improved by artificial drainage and, if adequately drained, would be suitable for tilled crops. Draining of the Roanoke soil, however, is difficult and of doubtful practicability.

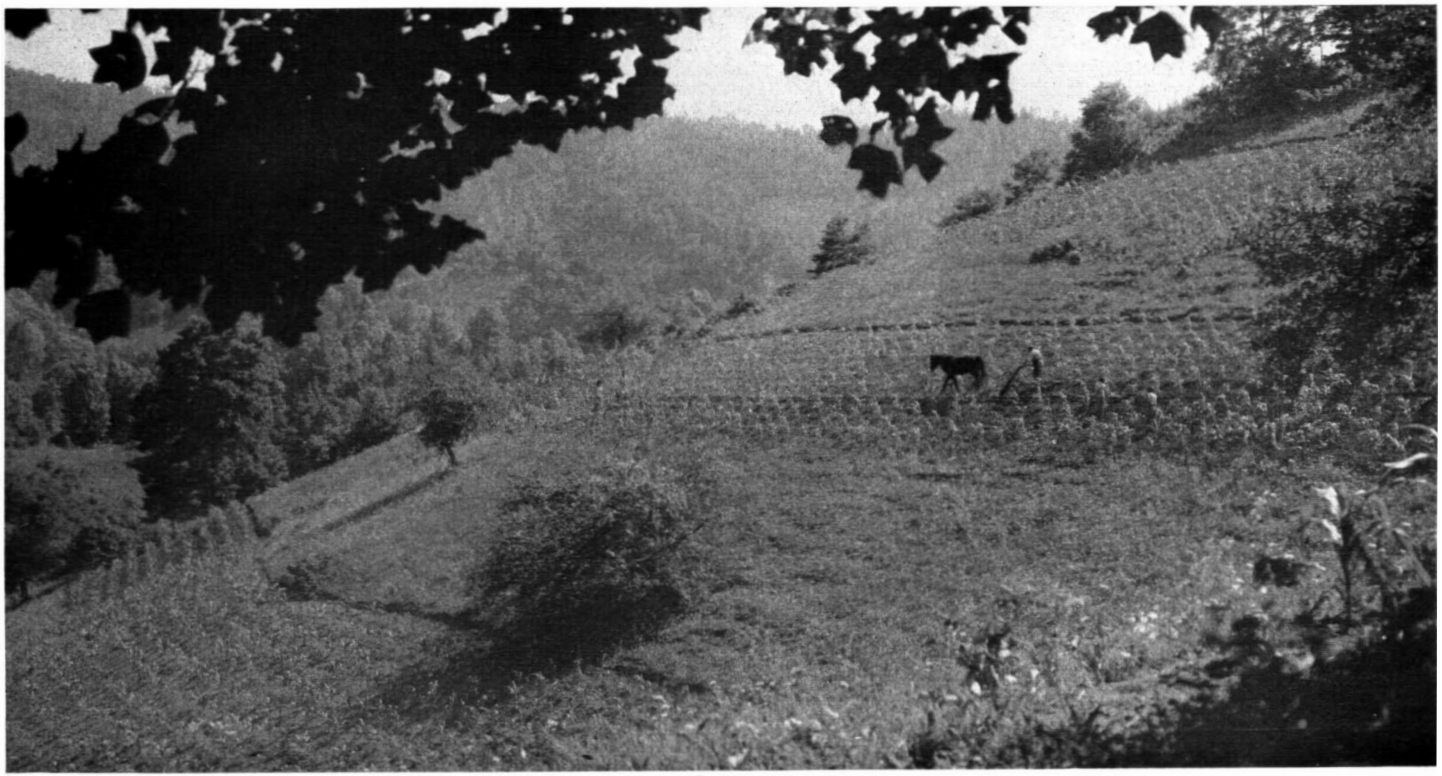
The soils of management group 16 and their workability, conservability, productivity, and use class are given in table 19.

TABLE 19.—*Workability, conservability, productivity, and use class of the soils of management group 16, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Roanoke silt loam	Fair	Poor	Low	4
Wehadkee loam	Poor	Fair	do	4

Management requirements.—Group 16 soils furnish a fair quantity of pasture through spring, summer, and fall, but the quality is only poor to fair. The first step in pasture improvement should be to improve moisture conditions. Drainage can be improved considerably in most places by using open ditches. Tiling probably would be effective on the Wehadkee soil, but, because of the claypan, would not be so practical on the Roanoke. After drainage has been improved, seedings of bluegrass, white clover, redtop, and lespedeza will do fairly well, especially if lime and phosphate are used. Redtop and lespedeza grow successfully without amendments, but pasture is of lower quality. Weeds should be controlled by grazing and mowing.

These soils are poorly suited to tilled crops but may be fairly well suited to crops that can be planted late in spring or early in summer and harvested in fall. Sorghum and soybeans are well suited to such use. If effectively drained, use and management practices are similar to those for soils such as the Chewacla, Hamblen, and Lindside; crop yields, however, would not be so high.



Contour strip cropping on Ashe soils.

View of Porters-Tusquitee-Balfour association; lower slopes of steep Porters soils are cleared and used for crops and pasture.

MANAGEMENT GROUP 17—HILLY STONY SOILS OF THE COLLUVIAL AND TERRACE LANDS

The soils of group 17 differ from those of group 7 chiefly in having steeper slopes (15 to 30 percent). They are deep permeable well-drained soils, but all contain rocks, cobblestones, or gravel that interfere with and in some places almost prohibit tillage. Workability is poor to very poor because the soils are hilly, stony, and consequently not generally suitable for crops. All have moisture conditions poor for plant growth, and most are low in natural fertility; therefore, they are not naturally productive of forage. Pasture, however, is their best use on most farms.

The soils of management group 17 and their workability, conservability, productivity, and use class are given in table 20.

TABLE 20.—*Workability, conservability, productivity, and use class of the soils of management group 17, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Allen stony loam:				
Eroded hilly phase	Poor	Fair	Medium	4
Hilly phase	do	do	do	4
Holston cobbly fine sandy loam, eroded hilly phase.	do	Poor	Low	4
Jefferson gravelly loam, eroded hilly phase.	do	do	do	4
Jefferson stony fine sandy loam:				
Eroded hilly phase	Very poor	do	do	4
Hilly phase	do	do	do	4
Masada gravelly silt loam, eroded hilly phase.	Poor	Fair	Medium	4
Tusquitee stony loam, hilly phase	do	do	High	4

Management requirements.—If good pasture is to be established and maintained on group 17 soils, moderate to heavy applications of lime and phosphate must be applied. A pasture mixture that includes bluegrass, orchard grass, white clover, hop clover, and lespedeza is well suited. Other management practices are proper control of grazing, scattering droppings, and eradicating weeds. If pastures are properly fertilized and grazed, weeds can be controlled. Stoniness and strong slopes make mowing a difficult and ineffective means of weed control in most areas. A good practice is growing an intertilled crop, as corn, once in every 8 or 10 years if weeds are crowding out the desirable pasture plants.

On some farms it may be necessary and desirable to use these soils for crops. If so, management will be similar to that for the soils of group 7. The crop rotation, however, will need to be longer and include more close-growing crops. Tillage should be on the contour.

MANAGEMENT GROUP 18—HILLY RED PLASTIC SOILS CHIEFLY FROM HIGH-GRADE LIMESTONE (SEVERELY ERODED); AND STONY, HILLY, AND ROLLING LAND TYPES

Group 18 includes well-drained heavy red soils of the uplands. These soils differ from those of group 13 either in being severely eroded or in being so stony as to make their tillage impractical. The severely

eroded areas have lost most of the original surface layer and in many places a part of the subsoil by accelerated erosion. Shallow gullies are common. The stony land types in most places have a heavy clayey surface layer in addition to being stony. In general all of the members of this group have a low content of organic matter and plant nutrients and are low in water-holding capacity. Good tilth is difficult to maintain, and the soils can be worked only within a very narrow range of moisture conditions.

These soils are considered poorly suited to crops requiring tillage because they have poor tilth conditions, strong slopes, extreme susceptibility to further erosion, or stoniness. They are probably best used for pasture on most farms.

Workability, conservability, productivity, and use class of the soils of management group 18 are given in table 21.

TABLE 21.—*Workability, conservability, productivity, and use class of the soils of management group 18, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Decatur silty clay loam, severely eroded hilly phase.	Poor	Very poor	Medium	4
Dunmore silty clay loam, severely eroded hilly phase.	do	do	Low	4
Fullerton silty clay loam, severely eroded hilly phase.	do	Poor	do	4
Stony hilly land (Dunmore soil material).	Very poor	Very poor	do	4
Stony rolling land (Dunmore soil material).	do	Poor	Medium	4

Management requirements.—Where group 18 soils are used for pasture that is already well established, the chief requirements are periodic application of lime and phosphate and mowing to control weeds. Occasional replanting may be necessary. If fertilization is adequate, grazing is properly controlled, and weeds are systematically eradicated, reseeding should be unnecessary and the pasture can be expected to improve with age.

Establishing pasture is difficult, largely because the soils are unfavorable in tilth, tend to clod and bake, absorb moisture slowly, and are extremely deficient in organic matter. Lime and phosphate are necessary, and potash may be needed. Nitrogen may aid in getting a desirable pasture stand established. Pasture mixtures should contain a considerable proportion of drought-resistant plants. Good practices are the seeding of alfalfa or sericea lespedeza on properly fertilized fields, grazing these after they are well established, and seeding the pasture mixture in the stubble. Applications of barnyard manure greatly aid in establishing plants on galled areas.

If these soils are used for tilled crops, a use to which they are poorly suited, management practices must be exacting. A plant cover needs to be maintained all or nearly all the time, and row crops should be avoided. Biennial and perennial close-growing crops should be selected in preference to annual crops that require preparation of the

seedbed every year. Grasses and legumes should be the chief crops in the rotation.

Cultivation should be on the contour. Terracing will not be practical because slopes are strong and the subsoils are heavy and slowly permeable, but contour ditches or diversion ditches may be beneficial in some places. Fertilization, addition of organic matter, and liming are essential. The stony land types included in this group are not suitable for crops because their workability is very poor.

MANAGEMENT GROUP 19—HILLY SHALLOW SHALY SOILS CHIEFLY FROM CALCAREOUS SHALE

Group 19 consists of shallow shaly soils of hilly relief. The uneroded soils are not deep; the eroded ones generally consist of a mixture of soil material and partly weathered shale only a few inches thick. Owing to extreme susceptibility to injury from erosion, crop injury from droughts, and relief, these soils are poorly or very poorly suited to tilled crops. Fair pastures can be maintained, however, under a high level of management. The soils are apparently well supplied with lime and potash in most places, but they are low in content of phosphorus and nitrogen. Water-holding capacity is low to very low.

The soils of this group and their workability, conservability, productivity, and use class are given in table 22.

TABLE 22.—*Workability, conservability, productivity, and use class of the soils of management group 19, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Dandridge shaly silt loam:				
Eroded hilly phase	Fair	Poor	Medium	4
Hilly phase	do	do	do	4
Teas-Litz shaly silty clay loams, eroded hilly phases.	do	do	Low	4
Teas-Litz silt loams, hilly phases	do	do	do	4
Teas shaly silt loam, hilly phase	do	do	Medium	4
Teas shaly silty clay loam, eroded hilly phase.	do	do	Low	4

Management requirements.—Although soils of group 19 are naturally fairly productive of pasture, they are responsive to good management practices. The chief fertilizer requirement is phosphorus, and liberal applications are needed at frequent intervals. Lime is generally needed on the Litz soils, but the other soils should be tested before any application. An initial application of potash may be necessary, but it probably will not be needed after the pasture is well established if droppings are kept scattered. Nitrogen may be needed in establishing pasture or if the percentage of legumes in the mixture is low. Applications of barnyard manure, especially on galled spots, aid greatly in establishing the pasture sod. Since pasture on these soils is subject to injury from drought, grazing must be carefully controlled, especially during dry periods. Emergency pasture is advisable for the dry summer and early fall months. Controlled grazing and the use of amendments are largely effective in the control of weeds, although clipping may be necessary.

MANAGEMENT GROUP 20—HILLY SHALLOW STONY SOILS FROM QUARTZITE, GRANITES, AND STONY COLLUVIUM

Shallow stony and hilly soils of the mountains are included in group 20. They differ from the soils of group 14 chiefly in containing enough stone on the surface and in the plow layer to interfere with tillage. The stoniness of some small areas almost prohibits tillage. Owing chiefly to stoniness and strong slopes, these soils are poorly to very poorly suited to crops that require tillage, but they are fairly well suited to pasture. As a group, they are moderately productive of pasture plants, but they vary greatly from one another in productiveness. Ramsey soils are low in natural fertility, whereas Burton and Porters soils are relatively high.

Management group 20 soils and their workability, conservability, productivity, and use class are given in table 23.

TABLE 23.—*Workability, conservability, productivity, and use class of the soils of management group 20, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Ashe stony loam:				
Eroded hilly phase	Fair	Fair	Medium	4
Hilly phase	do	do	do	4
Burton stony loam	Poor	do	High	4
Porters stony loam:				
Eroded hilly phase	do	do	do	4
Hilly phase	do	do	do	4
Ramsey stony fine sandy loam, hilly phase.	do	Poor	Very low	4
Stony colluvium (Tusquitee and Jefferson soil materials).	Very poor	Fair	Low	4

Management requirements.—Fair to good pasture can be established and maintained on group 20 soils by management concerned chiefly with supplying amendments and controlling grazing and weeds. Lime and phosphate are general requirements for good yields; potash may be needed to establish pasture on the Ramsey soil. Nitrogen may be needed in establishing a pasture sod and also on established pasture having few legume plants in the stand. If properly fertilized, soils of this group are suited to bluegrass, orchard grass, redtop, white clover, hop clover, and lespedeza. Control of weeds will not be so difficult if pasture is properly grazed and fertilized. Growing an intertilled crop at 7- to 10-year intervals may be necessary to eliminate weeds in some pastures.

MANAGEMENT GROUP 21—STEEP NONSTONY SOILS

Group 21 consists of steep relatively stone-free soils of the uplands. The steep slopes, combined with one or more other undesirable characteristics or conditions, such as low fertility, shallowness, severe erosion, or extreme susceptibility to erosion, make these soils poorly or very poorly suited to crops, but they are poor to fair pasture land. On many farms, however, they are probably best left in forest or should be reforested if cleared.

Workability, conservability, productivity, and use class of the soils of management group 21 are given in table 24.

TABLE 24.—*Workability, conservability, productivity, and use class of the soils of management group 21, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Ashe loam:				
Eroded steep phase	Poor	Poor	Low	4
Steep phase	do	do	do	4
Ashe sandy loam:				
Eroded steep phase	do	do	do	4
Steep phase	do	do	do	4
Dandridge shaly silt loam:				
Eroded steep phase	Very poor	Very poor	do	4
Steep phase	do	do	do	4
Decatur silty clay loam:				
Eroded steep phase	do	do	Medium	4
Severely eroded steep phase.	do	do	Low	4
Dunmore silt loam, steep phase.	do	do	Medium	4
Dunmore silty clay loam:				
Eroded steep phase	do	do	Low	4
Severely eroded steep phase.	do	do	do	4
Fullerton loam, eroded steep phase.	do	Poor	do	4
Fullerton silt loam:				
Eroded steep phase	do	do	do	4
Steep phase	do	do	do	4
Porters loam, eroded steep phase.	Poor	do	Medium	4
Teas shaly silt loam, steep phase.	Very poor	Very poor	Low	4
Teas shaly silty clay loam, eroded steep phase.	do	do	do	4
Teas-Litz shaly silt loams, steep phases.	do	do	do	4
Teas-Litz shaly silty clay loams, eroded steep phases.	do	do	do	4

Management requirements.—Although the soils of group 21 are not generally productive of pasture, fair to good pasture can be established and maintained by good management. Lime and phosphate are needed on practically all the soils, and some potash may be needed in establishing pasture. Nitrogen may be needed to establish pasture or on stands that have a low proportion of legumes. Although amendments are needed on most of these soils, they may be very difficult or almost impossible to apply, especially on the mountain soils. If the soils are properly fertilized, bluegrass, orchard grass, redtop, white clover, red clover, hop clover, and lespedeza are suited. Grazing should be carefully controlled to aid in controlling weeds and maintaining a good sod. Weed control is difficult, but the less steep areas can be mowed.

Although these soils are poorly suited to crops, they may be required for cropland on some farms. When so used, lime, phosphorus, and possibly potassium should be supplied; nitrogen and humus increased and maintained; and soil moisture and soil material conserved.

Long rotations of close-growing hay and small-grain crops are best suited. All tillage should be approximately on the contour; contour strip cropping may be desirable.

MANAGEMENT GROUP 22—STEEP STONY SOILS

The steep and stony soils of group 22 are very poorly suited to crops and poorly suited to pasture. On most farms, they are probably best used for forest. They vary greatly in depth to bedrock, content of plant nutrients and organic matter, and water-holding capacity.

Workability, conservability, productivity, and use class of the soils of management group 22 are given in table 25.

TABLE 25.—*Workability, conservability, productivity, and use class of the soils of management group 22, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Allen stony loam:				
Eroded steep phase	Very poor	Poor	Low	5
Steep phase	do	do	do	5
Ashe stony loam:				
Eroded steep phase	do	do	do	5
Steep phase	do	do	do	5
Jefferson stony fine sandy loam:				
Eroded steep phase	do	Very poor	Very low	5
Steep phase	do	do	do	5
Masada gravelly silt loam, eroded steep phase.	do	Poor	Low	5
Porters stony loam:				
Eroded steep phase	do	do	Medium	5
Steep phase	do	do	do	5
Ramsey stony fine sandy loam, steep phase.	do	Very poor	Very low	5

Management requirements.—Much of the acreage of group 22 soils is in forest, and the remaining area should probably be reforested. In places, a suitable forest cover will establish itself if properly protected against fire and grazing by livestock; in others, planting will be necessary.

Forest management practices include (1) maintenance of a full stand of desirable species; (2) systematic cutting and weeding of trees; (3) harvesting mature trees in such a manner that desirable species may succeed them; and (4) the control, so far as possible, of fires, browsing, trampling, and damage from other causes. Forest damage is controlled by both soil and forest management. For a more detailed discussion of reforestation and forest management, see the section on Forests.

Although these soils are not suited to crops and pasture, small areas are used for such purposes. Where production of tilled crops must be attempted, adequate liming and fertilizing and every reasonable supporting practice for water control are needed. The use of amendments and careful selection and rotation of crops are especially needed to encourage heavy vegetation. Strip cropping may be advisable on some slopes.

Addition of lime and fertilizer, particularly phosphorus, and other good management practices are required to maintain pasture. In general, legumes should compose a considerable part of the pasture sod. It is difficult to apply amendments and to control weeds in many places because of the steep slopes, stoniness, and inaccessibility.

MANAGEMENT GROUP 23—VERY STEEP SOILS, ROUGH GULLIED LAND, STONY ROUGH LAND, AND ROCKLAND

The soils of management group 23 have some characteristic or combination of characteristics, such as extreme stoniness, very steep slopes, or severe gullying, that largely preclude their use for either crops or pasture. These soils and their workability, conservability, productivity, and use class are given in table 26.

Management requirements.—A large part of group 23 soils are in forest at present, and in general, reforestation should be carried out on the remaining acreage. For a discussion of reforestation and forest management, see management group 22 and the section on Forests.

TABLE 26.—*Workability, conservability, productivity, and use class of the soils of management group 23, Carter County, Tenn.*

Soil	Workability	Conservability	Productivity	Use class
Ashe stony loam, very steep phase.	Very poor	Very poor	Very low	5
Dandridge shaly silt loam, very steep phase.	do	do	do	5
Limestone rockland	do	do	do	5
Porters stony loam, very steep phase.	do	do	Low	5
Quartzite and granite rockland.	do	do	Very low	5
Ramsey stony fine sandy loam, very steep phase.	do	do	do	5
Rough gullied land:				
Ashe and Porters soil materials.	do	do	do	5
Dandridge soil material.	do	do	do	5
Dunmore and Fullerton soil materials.	do	do	do	5
Stony rough land:				
Dunmore and Teas soil materials.	do	do	do	5
Porters and Ashe soil materials.	do	do	do	5
Ramsey soil material	do	do	do	5
Teas-Litz shaly silt loams, very steep phases.	do	do	do	5
Teas shaly silt loam, very steep phase.	do	do	do	5

EXPECTABLE CROP YIELDS FOR THE SOILS OF CARTER COUNTY

Crop yields to be expected over a period of years on the soils of the county under two levels of management are shown in table 27. Yields on soil under two levels of management can be compared, as well as yields on different soils under the same level of management.

TABLE 27.—*Average acre yields of principal crops to be expected over a period of years under two levels of management on the soils of Carter County, Tenn.*

[Yields in columns A are expected under the most common practices of management; those in columns B are expected under good practices of management]

Soil	Corn		Wheat		Oats		Lespedeza hay		Red clover hay		Cabbage		Tobacco		Pasture	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Lb.*	*Lb.*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Allen loam:																
Eroded rolling phase	25	40	9	16	18	30	0.8	1.1	1.1	1.5	7	11	825	1,275	55	95
Rolling phase	30	45	10	18	22	32	.9	1.2	1.2	1.6	8	12	875	1,350	60	95
Undulating phase	35	48	11	19	23	33	.9	1.3	1.3	1.7	9	13	950	1,425	65	95
Allen stony loam:																
Eroded hilly phase	10	20	5	13	10	23	.5	.7	.8	1.2	(2)	(2)	(2)	(2)	45	85
Eroded rolling phase	20	35	8	15	16	28	.6	.9	1.0	1.4	6	10	600	1,050	50	90
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	40	70
Hilly phase	(3)	25	(3)	14	(3)	25	(3)	.8	(3)	1.3	6	10	(2)	(2)	45	85
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	75
Altavista silt loam	30	55	14	23	20	40	1.1	1.4	1.1	1.7	7	10	1,400	1,750	60	100
Ashe loam:																
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	.7	(2)	(2)	(2)	(2)	(2)	(2)	30	70
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(3)	.8	(2)	(2)	(2)	(2)	(2)	(2)	(3)	75
Ashe sandy loam:																
Eroded hilly phase	15	30	7	12	17	28	.3	.6	.8	1.2	5	8	(3)	800	35	70
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	65
Hilly phase	(3)	35	(3)	16	(3)	30	(3)	.8	(3)	1.2	(3)	10	(3)	1,000	(3)	80
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	70
Ashe stony loam:																
Eroded hilly phase	15	30	7	11	17	28	.3	.6	.8	1.2	6	8	600	800	50	70
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	55
Hilly phase	(3)	35	(3)	16	(3)	30	(3)	.8	(3)	(2)	(3)	10	(2)	1,000	(3)	75
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	60
Very steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Balfour loam:																
Hilly phase	22	45	11	20	15	30	.6	1.3	.9	1.5	8	12	(2)	1,100	55	90
Rolling phase	30	55	14	22	20	40	.7	1.5	1.1	1.6	10	14	1,200	1,500	60	95
Buncombe loamy, fine sand	15	30	5	10	10	25	.6	.8	.7	.9	(3)	(3)	(2)	(2)	15	40
Burton stony loam	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	70
Camp silt loam:																
Hilly phase	25	40	10	16	18	33	.7	1.2	1.1	1.4	(3)	(3)	1,250	1,700	75	95
Rolling phase	35	50	12	18	28	38	1.0	1.5	1.3	1.6	10	14	1,450	1,900	90	110
Undulating phase	40	55	14	20	30	40	1.1	1.6	1.4	1.7	11	15	1,550	2,000	95	115
Camp stony silt loam, rolling phase	28	40	10	16	18	33	.8	1.3	1.2	1.5	8	12	1,250	1,700	75	95
Chewacla fine sandy loam	35	60	(2)	(3)	(2)	(3)	1.3	1.6	(2)	(3)	(3)	14	(2)	(2)	80	105

Chewacla gravelly fine sandy loam	25	40	(2)	(3)	(2)	(3)	1.1	1.4	(2)	(3)	(3)	10	(2)	(2)	60	95
Clarksville cherty silt loam:																
Eroded hilly phase	15	25	6	14	10	25	.6	1.0	.9	1.3	6	8	(2)	900	45	85
Eroded rolling phase	25	38	10	16	20	30	.8	1.2	1.2	1.6	7	9	750	1,200	50	90
Hilly phase	(2)	30	(3)	15	(3)	28	(3)	1.0	(2)	1.3	7	9	(2)	1,000	45	85
Cobbly alluvium (Hamblen soil material)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	60	90
Congaree fine sandy loam	40	65	14	18	30	40	1.2	1.6	1.4	1.8	9	14	1,400	1,800	90	100
Congaree loam	45	70	14	20	35	45	1.3	1.8	1.5	2.0	10	16	1,500	1,900	110	125
Dandridge shaly silt loam:																
Eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	.4	.6	(2)	(2)	(2)	(2)	(2)	(2)	35	75
Eroded rolling phase	13	18	5	10	10	20	.5	.8	.7	1.1	(2)	(2)	300	750	45	85
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	65
Hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	.6	(2)	(2)	(2)	(2)	(2)	(2)	(3)	75
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	65
Very steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	20	40
Decatur silty clay loam:																
Eroded hilly phase	30	45	13	21	23	40	.9	1.3	1.3	1.7	(3)	(3)	(2)	(3)	55	95
Eroded rolling phase	40	55	21	29	40	55	1.2	1.6	1.5	1.9	8	12	1,350	1,750	65	105
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	45	80
Severely eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	.5	1.0	.7	1.3	(2)	(2)	(2)	(2)	30	70
Severely eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	70
Dunmore silt loam:																
Hilly phase	(3)	45	(3)	20	(3)	38	(3)	1.3	(3)	1.7	(3)	10	(3)	(3)	(3)	95
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	75
Dunmore silty clay loam:																
Eroded hilly phase	23	35	11	19	20	35	.9	1.3	1.3	1.7	6	10	(2)	(3)	55	90
Eroded rolling phase	35	50	13	21	23	40	1.0	1.4	1.4	1.8	7	11	1,050	1,500	60	100
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	65
Severely eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	.5	1.0	.7	1.3	(2)	(2)	(2)	(3)	30	70
Severely eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	50
Emory silt loam:																
Rolling phase	50	60	20	25	40	50	1.1	1.7	1.5	1.9	9	15	1,600	2,000	100	115
Undulating phase	55	65	23	29	45	55	1.2	1.8	1.6	2.0	10	16	1,800	2,225	110	125
Fullerton loam:																
Eroded hilly phase	20	35	8	15	13	30	.6	1.0	.9	1.3	5	8	(2)	(3)	50	90
Eroded rolling phase	33	45	13	19	23	35	.8	1.2	1.2	1.6	6	10	900	1,425	55	95
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	40	80
Hilly phase	(3)	40	(3)	18	(3)	33	(3)	1.1	(3)	1.5	(3)	9	(3)	(3)	(3)	90
Fullerton silt loam:																
Eroded hilly phase	23	35	11	19	18	30	.7	1.1	1.0	1.4	6	9	(2)	(3)	55	90
Eroded rolling phase	33	45	13	19	23	35	.8	1.2	1.2	1.6	6	10	1,000	1,500	55	95
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	70
Hilly phase	(3)	45	(3)	20	(3)	35	(3)	1.2	(3)	1.6	7	10	(3)	(3)	(3)	95
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	80
Fullerton silty clay loam, severely eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	70
Greendale silt loam:																
Rolling phase	40	50	16	22	30	40	1.0	1.5	1.3	1.7	7	13	1,450	1,900	60	100
Undulating phase	45	55	18	24	33	43	1.1	1.6	1.4	1.8	8	14	1,650	2,100	65	110
Groseclose silt loam:																
Eroded hilly phase	20	30	6	15	13	30	.6	1.0	.9	1.3	5	9	(2)	(3)	50	90
Eroded rolling phase	30	43	11	19	23	33	.9	1.3	1.3	1.7	6	10	900	1,350	55	95
Hamblen loam	45	60	(2)	(3)	(2)	(3)	.9	1.6	(2)	(3)	(3)	14	(2)	(3)	110	120

See footnotes at end of table.

TABLE 27.—*Average acre yields of principal crops to be expected over a period of years under two levels of management on the soils of Carter County, Tenn.*—Continued

[Yields in columns A are expected under the most common practices of management; those in columns B are expected under good practices of management]

Soil	Corn		Wheat		Oats		Lespedeza hay		Red clover hay		Cabbage		Tobacco		Pasture	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Lb.*	*Lb.*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Hayter loam:																
Rolling phase	40	55	15	24	35	50	1.3	1.6	1.4	1.9	9	13	1,400	1,900	80	110
Undulating phase	45	60	20	28	40	55	1.4	1.8	1.6	2.1	10	14	1,600	2,100	90	120
Hayter stony loam:																
Rolling phase	30	45	13	20	30	40	1.1	1.3	1.2	1.6	6	10	1,200	1,700	60	100
Undulating phase	35	50	15	24	35	45	1.2	1.4	1.3	1.7	7	11	1,300	1,800	65	105
Hiwassee clay loam:																
Eroded hilly phase	30	45	13	21	25	40	.9	1.3	1.2	1.7	(2)	(3)	(3)	(3)	50	80
Eroded rolling phase	35	55	16	26	40	55	1.1	1.5	1.4	1.9	9	13	1,400	1,800	70	110
Eroded undulating phase	40	60	18	28	43	58	1.2	1.6	1.5	2.0	10	14	1,550	2,000	70	110
Holston cobbly fine sandy loam:																
Eroded hilly phase	10	20	5	13	10	23	.5	.8	.8	1.2	(2)	(3)	(2)	(2)	40	80
Eroded rolling phase	13	28	6	15	13	28	.6	1.1	.9	1.4	5	8	375	825	45	85
Holston fine sandy loam, eroded rolling phase	18	35	8	16	15	30	.7	1.1	1.0	1.5	6	10	525	975	50	90
Jefferson fine sandy loam, eroded rolling phase	18	35	8	16	15	30	.7	1.1	1.0	1.5	6	10	500	975	50	90
Jefferson gravelly loam:																
Eroded hilly phase	10	25	5	12	10	20	.5	1.0	.7	1.1	(2)	(3)	(2)	(3)	30	65
Eroded rolling phase	15	30	5	13	12	25	.6	1.1	.8	1.3	4	8	550	900	35	80
Eroded undulating phase	20	40	8	18	18	35	.8	1.3	1.0	1.5	6	10	700	1,025	45	90
Rolling phase	18	35	6	15	15	30	.7	1.2	.9	1.4	5	9	700	1,025	40	85
Jefferson stony fine sandy loam:																
Eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	.8	(2)	(2)	(2)	(2)	(2)	(2)	35	75
Eroded rolling phase	10	25	5	14	10	25	.5	1.0	.8	1.3	4	8	300	750	40	80
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	60
Hilly phase	(3)	25	(3)	13	(3)	25	(3)	1.0	(3)	1.2	(3)	7	(2)	(2)	(3)	75
Rolling phase	15	30	9	15	13	28	.6	1.1	.9	1.4	5	9	400	850	45	85
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	65
Undulating phase	18	35	6	15	13	30	.6	1.1	.9	1.4	6	10	450	900	45	85
Leadvale silt loam	20	35	9	16	18	30	.7	1.1	1.1	1.5	(3)	8	600	1,050	50	90
Limestone rockland	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Lindside silt loam	45	63	(2)	(3)	(2)	(3)	1.0	1.6	(2)	(3)	(3)	14	(2)	(3)	115	130
Masada gravelly silt loam:																
Eroded hilly phase	18	30	8	15	13	28	.5	1.0	.9	1.3	(2)	(3)	(2)	(3)	45	85
Eroded rolling phase	25	40	9	16	18	30	.6	1.1	1.1	1.4	4	8	900	1,350	50	90
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	70
Undulating phase	30	45	12	20	20	35	.7	1.2	1.0	1.5	7	10	1,200	1,600	60	90

Masada silt loam:																
Eroded rolling phase	35	50	14	22	25	40	.9	1.3	1.2	1.6	8	11	1,200	1,600	60	100
Undulating phase	40	55	19	26	35	50	1.1	1.4	1.4	1.8	9	13	1,400	1,800	70	110
Matney loam, rolling phase	25	45	10	18	20	35	.6	1.4	1.0	1.5	9	13	1,100	1,400	60	95
Nolichucky fine sandy loam:																
Eroded hilly phase	20	30	8	15	13	28	.6	1.0	.9	1.3	4	8	(2)	(3)	50	90
Eroded rolling phase	28	40	9	16	18	30	.8	1.1	1.1	1.5	6	10	825	1,275	55	95
Ooltewah silt loam	45	63	10	20	20	40	.9	1.6	(2)	(2)	(3)	14	(2)	(3)	110	120
Perkinsville loam:																
Eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	.4	1.0	(2)	(2)	(2)	8	(2)	(3)	40	70
Eroded rolling phase	20	45	10	18	18	35	.5	1.3	.9	1.4	7	11	900	1,200	55	85
Hilly phase	(2)	30	(2)	15	(2)	25	.4	1.1	(2)	(2)	(2)	9	(2)	(3)	45	75
Rolling phase	25	50	12	20	20	40	.6	1.4	1.0	1.5	8	12	1,100	1,400	60	90
Porters loam, eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	.4	.8	(2)	(2)	(2)	(2)	(2)	(2)	50	80
Porters stony loam:																
Eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	.4	.8	(2)	(2)	(2)	(2)	(2)	(2)	40	75
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	40	60
Hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	(3)	1.0	(2)	(2)	(2)	(2)	(2)	(2)	45	80
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	50	70
Very steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Quartzite and granite rockland	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Ramsey stony fine sandy loam:																
Hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	25	45
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Very steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Roanoke silt loam	(2)	30	(2)	(2)	(2)	(2)	.5	1.0	(2)	(2)	(2)	(2)	(2)	(2)	40	90
Rough gullied land:																
Ashe and Porters soil materials	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Dandridge soil material	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Dunmore and Fullerton soil materials	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Sequatchie gravelly loam	30	40	14	20	23	38	.9	1.2	1.2	1.6	8	12	1,200	1,600	50	90
Sequatchie loam	40	50	18	25	28	43	1.1	1.4	1.4	1.8	10	14	1,425	1,875	60	100
Staser fine sandy loam	45	65	11	18	25	35	1.1	1.6	1.3	1.7	12	16	1,350	1,725	105	120
State loam	40	60	14	25	35	50	1.0	1.6	1.4	2.0	10	14	1,600	2,000	80	110
Stony colluvium (Tusquitee and Jefferson soil materials)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	20	40
Stony hilly land (Dunmore soil material)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	25	45
Stony rolling land (Dunmore soil material)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	50
Stony rough land:																
Dunmore and Teas soil materials	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	15	35
Porters and Ashe soil materials	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Ramsey soil material	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Tate loam:																
Hilly phase	30	45	10	20	20	35	1.0	1.5	1.1	1.7	9	13	(2)	(3)	75	100
Rolling phase	40	60	14	23	30	45	1.1	1.6	1.2	1.8	12	16	1,400	1,800	85	115
Teas-Litz shaly silt loams:																
Steep phases	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	65
Very steep phases	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Teas-Litz shaly silty clay loams:																
Eroded hilly phases	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	65
Eroded steep phases	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	60
Teas-Litz silt loams hilly phases	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	70
Teas-Litz silty clay loams, eroded rolling phases	13	18	5	10	10	20	.5	.8	.7	1.1	(2)	(2)	300	750	45	85

See footnotes at end of table.

TABLE 27.—*Average acre yields of principal crops to be expected over a period of years under two levels of management on the soils of Carter County, Tenn.*—Continued

[Yields in columns A are expected under the most common practices of management; those in columns B are expected under good practices of management]

Soil	Corn		Wheat		Oats		Lespedeza hay		Red clover hay		Cabbage		Tobacco		Pasture	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Lb.*	*Lb.*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Teas shaly silt loam:																
Hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	.6	(2)	(2)	(2)	(2)	(2)	(2)	(3)	70
Steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	60
Very steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Teas shaly silty clay loam:																
Eroded hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	30	65
Eroded steep phase	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	50
Tusquitee loam:																
Eroded hilly phase	30	50	12	22	25	45	1.0	1.5	1.1	1.7	10	14	(2)	(3)	80	110
Rolling phase	40	60	14	24	30	50	1.1	1.6	1.2	1.8	12	16	1,500	1,900	90	120
Undulating phase	45	65	16	25	35	55	1.2	1.7	1.3	1.9	13	17	1,600	2,000	95	125
Tusquitee stony loam:																
Hilly phase	(2)	(2)	(2)	(2)	(2)	(2)	.8	1.3	(2)	(2)	(2)	(2)	(2)	(2)	65	95
Rolling phase	30	50	12	20	25	40	.9	1.4	1.0	1.5	10	14	1,300	1,700	75	105
Wehadkee loam	(2)	30	(2)	(2)	(2)	(2)	.6	1.1	(2)	(2)	(2)	(2)	(2)	(2)	30	80

[1] Cow-acre-days used to express the carrying capacity of pasture land, is the product of the number of animal units carried per acre multiplied by the number of days during the year the animals are grazed without injury to the pasture; for example, a soil that supports 1 animal unit per acre for 360 days rates 360; a soil that supports 1 animal unit on 2 acres for 180 days rates 90; and a soil that supports 1 animal unit on 4 acres for 100 days rates 25.

[2] Crop not commonly grown, and the soil is physically unsuitable for its production under the management specified.

[3] Crop not commonly grown, but the soil is considered suitable, although less suitable than for crops for which yields are given.

In columns A, the yields given are those that may be expected under the prevailing practices of soil management. The practices are not the same on all soils nor are they the same for any given soil in different parts of the county or on different farms, but it is believed that the practices described for each soil in the section on Descriptions of Soil Units are representative of current management practices. The yields are based largely on observations made by members of the soil survey party, on information obtained by interviews with farmers and other agricultural workers who have had experience with the soils and crops of the area, and on comparisons with yield estimates for other counties in Tennessee on similar soils.

In columns B are given yields thought to represent those that may be expected 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; mechanical means of water control in order to maintain or increase productivity; maintaining or improving workability; and conserving soil material, plant nutrients, and soil moisture. The management requirements given in the section on Use and Management of Important Groups of Soils indicate the principal features of good soil management for the different soils. There can be no rigid definition of good management because the requirements for good management of any particular soil vary among individual farms.

By comparing yields listed in columns B with those in columns A, some idea of the responses to be expected from good management is obtained. Yields in columns B can be used as production goals that can be attained by feasible practices; they are based on the best evidence obtainable, which for some soils is meager. Where yield experience is lacking, the known deficiencies of the soils offer evidence of their potential responses to treatment. On practically all the soils in the county more intensive management will bring profitable increases in yields.

INTERPRETIVE SOIL GROUPINGS AND MAPS

The detailed soil map (cover page 3) is suitable for obtaining information about specific tracts of land. The soils shown on it can be grouped in various ways to bring out the location of all soils with some particular characteristic, as stoniness, steep slopes, poor drainage, suitability to alfalfa, or need for lime. In the section on Use and Management of Important Groups of Soils, soils are grouped according to similarity in use suitability and management requirements. These management groups are shown on the detailed soil map by distinguishing colors.

In the following pages the soils are grouped and discussed according to (1) use classes—the degree of suitability or desirability for farming—and (2) broad landscapes, or soil associations. The use classes—First-, Second-, Third-, Fourth-, and Fifth-class soils—are not expressed on a map, but they closely correlate with the groups discussed in the section on Use and Management of Important Groups of Soils and shown by color on the detailed soil map. Management groups 1 through 15 consist mainly of First-, Second-, and Third-class soils; groups 16 through 21, Fourth-class soils; and 22 and 23, Fifth-class soils.

USE CLASSES

Productivity, workability, and conservability determine the physical suitability of soils for agricultural use. On the basis of their relative physical suitability for the present agriculture, the soils of Carter County are grouped into five classes—First-, Second-, Third-, Fourth-, and Fifth-class soils. The tables in the section on Use and Management of Important Groups of Soils give the use class for each soil.

FIRST-CLASS SOILS

First-class soils are productive, easy to work, easy to conserve, and, consequently, well suited to the crops common to the county. They are good to excellent both for crops requiring tillage and for permanent pasture.

Compared with other soils of the county, all are relatively well supplied with plant nutrients, but for some crops they all respond when fertilized. They contain more lime than most other soils of the county but are usually slightly deficient in this element. All are well drained, but retain moisture well and provide an adequate and even supply for plant growth. Good tilth is easily obtained and maintained; the range of moisture conditions for tillage is comparatively wide. The soils are fairly well supplied with organic matter in comparison with others of the county. Their physical properties favor normal circulation of air and moisture, and roots penetrate all parts of the subsoil freely.

None of these soils hos any prominent adverse soil condition. All are almost free of stone and have relief favorable to soil conservation and tillage; none is severely eroded or highly susceptible to erosion. Natural fertility is relatively high, tillage is easy, and conservation of soil fertility and soil material is relatively simple.

SECOND-CLASS SOILS

Second-class soils are good for agricultural use. They are fair to good for crops requiring tillage and fair to excellent for permanent pasture.

These soils are at least moderately productive of most of the crops commonly grown in the area. Their physical properties are moderately favorable for tillage, maintenance of good tilth, ad normal circulation and retention of moisture. None occupies slopes greater than 12 to 15 percent, has enough stones to interfere seriously with tillage, or is severely eroded. Each is moderately deficient in one or more properties that contribute to productivity, workability, or conservability; but none is so seriously deficient in any property that it is poorly suited to tilled crops.

Deficiencies vary widely among these soils. Some are fertile but sloping and moderately eroded; others are almost level and uneroded but relatively low in content of plant nutrients or have restricted drainage. Management requirements range widely among the soils because many different kinds of soils are in this class. These soils are relatively similar in suitability for agriculture, although management practices by means of which the benefits of their suitability may be realized are greatly different.

THIRD-CLASS SOILS

Third-class soils are fair for agricultural use—poor to fair for crops requiring tillage and fair to very good for permanent pasture.

Each soil is so deficient in workability, conservability, productivity, or in some combination of the three that its suitability for tilled crops is definitely limited. These soils are better suited to crops requiring tillage than the Fourth-class soils, but are less well suited than Second-class soils. One or more conditions—low content of plant nutrients or organic matter; low water-holding capacity; undesirable texture, structure, or consistence; strong slope; chertiness; or inadequate natural drainage—limit their suitability for crops requiring tillage. Because characteristics among these soils are diverse, management requirements range widely.

FOURTH-CLASS SOILS

Fourth-class soils are poor for crops requiring tillage and poor to very good for permanent pasture. They are poor agricultural soils mainly because they are suited to only a limited number of uses. Nevertheless, some of them may be important on farms where land suited to permanent pasture is in great demand.

Each soil is so difficult to work or to conserve, or both, that the management practices necessary for the successful growing of tilled crops are not now feasible. On some farms, however, soils well suited to tilled crops may be so limited that it is necessary to practice the intensity of soil management needed to grow tilled crops successfully on Fourth-class soils.

Fourth-class soils are generally used for pasture on farms where an adequate acreage of soils well suited to crops is available. A considerable acreage is used for crops, mainly on farms where acreages of soils better suited to crops are too small to satisfy the needs of the farm unit.

Generally, the intensity of management practiced on areas of these soils used for crops is not adequate for good soil conservation. As on Third-class soils, management requirements, both for crops that require tillage and for pasture, vary widely among Fourth-class soils.

FIFTH-CLASS SOILS

Fifth-class soils are very poorly suited to agriculture—very poor for crops requiring tillage and poor to very poor for permanent pasture.

Each is so difficult to work, so difficult to conserve, so low in productivity, or has such combinations of these unfavorable properties that it is generally not feasible to apply the intensity of management necessary for successful growing of tilled crops. Each is so low in content of plant nutrients or so poor in moisture relations, or both, that common pasture plants produce little feed. These soils are apparently best suited to forest under present conditions, even though they are likely less productive of forest than soils of any of the preceding groups. Conditions in the locality or on the farm unit may require the use of some of these soils for pasture or crops, in spite of the fact that they are poorly suited to either use in their present condition.

SOIL ASSOCIATIONS

Soils occur in a rather characteristic geographic association. The Clarksville soils, for example, are generally associated with the Fuller-

ton and Greendale soils. Likewise, the Congaree soils are generally associated with Chewacla soils of the bottoms and State soils of the low terraces. A farm or even a field rarely consists of only one soil. It is possible to prepare from the detailed soil map a generalized map which shows the areas dominated by each group of such associated soils. The soils of Carter County have been placed into 17 such soil association areas, each having its characteristic pattern of soils that occur in association with one another. A generalized map has been prepared from the detailed soil map showing the geographic distribution of these soil association areas (fig. 3).

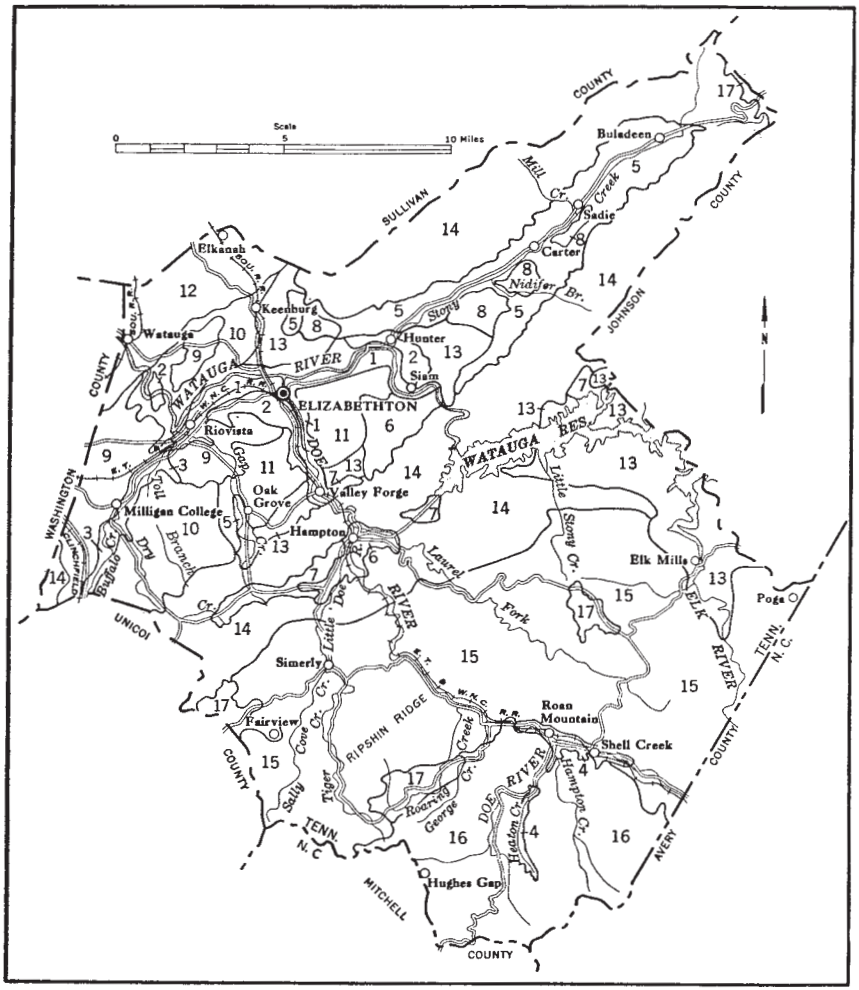


FIGURE 3.—Soil associations of Carter County, Tenn.: 1, Congaree-State-Chewacla; 2, Hiwassee-Masada-Altavista; 3, Staser-Hamblen-Sequatchie; 4, Tusquitee-Congaree-Chewacla; 5, Jefferson-Allen-Sequatchie; 6, Jefferson-Masada-cobbly alluvium; 7, Jefferson-Allen-Teas; 8, Decatur-Dunmore-stony land; 9, Dunmore-Fullerton-stony land; 10, Fullerton-stony land-Clarksville; 11, Stony land-Fullerton-Clarksville; 12, Dandridge-Hamblen; 13, Teas-Litz-Camp; 14, Ramsey-Jefferson-Matney; 15, Ashe-Tusquitee-Perkinsville; 16, Porters-Tusquitee-Balfour; 17, Perkinsville-Balfour-Matney.

A soil association may consist of only a few or many soils, which may be similar or very different. The association in which a soil occurs, however, has an influence on its use. For example, a soil may be used intensively for corn if associated with soils unsuited to that crop, but may not be used intensively for corn if associated with soils well suited to that crop.

A brief discussion of each soil association area follows. More detailed information about the component soils can be obtained from the individual discussions in the section on Descriptions of Soil Units.

CONGAREE-STATE-CHEWACLA

The Congaree-State-Chewacla association, small in total area, includes some of the first bottoms and low terraces of the Watauga and Doe Rivers. It covers only about 2 percent of the total county, but owing to its location and its high percentage of productive crop soils, it is very important to the agriculture of the county.

The first bottoms and low terraces, somewhat undulating in relief, consist of natural levees near the rivers and other low ridges and intervening swales or sloughs that run nearly parallel to the rivers. Typically, Buncombe soil or Cobbly alluvium (Hamblen soil material) are on the natural levees, Congaree and Chewacla soils on the low first bottoms, State soil on the low terraces or second bottoms, and Chewacla and Wehadkee soils in the swales or depressed areas. Practically all of these soils are subject to overflow, although the State soil is overflowed only at very long intervals.

As a group, these are probably the most fertile and productive soils of the county; but chiefly because of periodic overflows and the imperfect and poor drainage of the Chewacla and Wehadkee soils, they are somewhat restricted in crop adaptation. Although probably not so well suited to alfalfa and small grains as some of the upland soils, they are fairly well suited to corn and some vegetable crops.

This association area has the highest percentage of cropland—about 90 percent—of any in the county. It is characterized by a general type of farming, but because of location, it naturally has many part-time farms. The area is small and therefore most of the farms include parts of adjacent soil associations. The homes, farm buildings, and most of the pastures are not on the bottom lands but are on the adjacent high terraces or uplands.

HIWASSEE-MASADA-ALTAVISTA

The Hiwassee-Masada-Altavista association occupies about 1.5 percent of the county and consists of old high terraces of the Watauga and Doe Rivers. The area has some undulating to hilly land but is predominantly rolling. In general, Hiwassee soils are on the higher better drained areas, Masada soils are on the high to moderately low slightly less well-drained areas, Altavista on the nearly level to undulating imperfectly to moderately well-drained areas, and Roanoke on the nearly level to slightly depressed poorly drained areas. The association also includes small areas of upland soils—the Fullerton, Clarksville, Dunmore, and Groseclose.

Second-class soils predominate, though small acreages of First-, Third-, and Fourth-class soils occur. Excepting the poorly drained Roanoke, these soils are well suited to practically all the common crops of the county and are relatively productive of most of them.

Fertilizer and lime are needed for continued high yields of most crops, but are not so essential as on adjacent upland soils. Most of the soils of this association are relatively well suited to intensive use for crops, although proper choice and rotation of crops is more important than on the Congaree-State-Chewacla association. These soils, as a group, respond very well to good management.

Much of this association is within the city limits of Elizabethton, where its onlya gricultural use is for home gardens. A general type of farming is practiced outside the city, but the area does include many small part-time farms.

STASER-HAMBLEN-SEQUATCHIE

The Staser-Hamblen-Sequatchie association consists chiefly of first bottom and low terrace soils. Less than 1 percent of the county is in this area, which is largely confined to the first bottoms of Buffalo Creek. Staser and Hamblen soils are on the first bottoms, and Sequatchie soils are on the low terraces. Small areas of Greendale and Emory soils of the colluvial lands and of Nolichucky and Holston soils of the high terraces are also included. The Staser and Hamblen soils are subject to periodic overflow, and some of the Sequatchie soils to occasional overflow.

These soils are well suited to intensive use for suitable crops. In general, they are fertile and productive, but owing to periodic overflow, the Staser and Hamblen soils are somewhat restricted in crop adaptation. The Sequatchie soils are very well suited to most of the common field crops of the county. The Staser and Hamblen soils, however, are not considered very well suited to alfalfa and small grain; they are best suited to corn, some hay crops, and vegetables. The soils of this association produce well without amendments, but they respond to complete fertilizer.

As this area is very narrow, possibly none of the farms are entirely within the association. A general, well-diversified type of farming is practiced, and only a few part-time or subsistence farms are included.

TUSQUITEE-CONGAREE-CHEWACLA

The Tusquitee-Congaree-Chewacla soil association is located in the mountainous part of the county and covers less than 1 percent of the total county area. The soils are mainly colluvial or alluvial, most of the material having washed from the steep Porters and Ashe soils on the adjacent uplands. Typically, Tusquitee soils are on the undulating to hilly colluvial foot slopes and Congaree or Chewacla soils are on the first bottoms. The association also includes a considerable acreage of Stony colluvium (Tusquitee and Jefferson soil materials).

These are fertile and productive soils, but use suitability of many of them is somewhat limited by imperfect drainage, susceptibility to overflow, or stoniness. As a group, they are relatively well suited to intensive use. They are moderately well supplied with plant nutrients and organic matter, but they respond well to applications of phosphorus and lime. Crop rotations, except possibly on the rolling and hilly Tusquitee soils, can be short. Most of these soils are fairly well suited to the common crops of the county and are especially well suited to potatoes, most vegetable crops, pasture, and hay.

Livestock farming is predominant, but there is a considerable number of subsistence farms. Most farms include some of the adjacent upland soils, some of which are used for pasture.

JEFFERSON-ALLEN-SEQUATCHIE

The Jefferson-Allen-Sequatchie soil association includes most of the Stony Creek valley and occupies about 5 percent of the county. It consists chiefly of colluvial and alluvial soils formed from material washed from the Ramsey soils on the adjacent mountains. The valley is U-shaped and nearly level to steep. The steeper slopes are generally adjacent to the surrounding mountains; the areas of milder relief, near the center of the association (pl. 8, *B*). Jefferson and Allen soils are on the undulating to steep colluvial foot slopes, cobbly alluvium (Hamblen soil material) on the nearly level first bottoms, and Sequatchie soils on the undulating stream terraces. Other less extensive soils are the Hamblen, Staser, Hayter, and a small acreage of associated upland soils.

As a group, these soils are fairly well suited to crops. On most of them stoniness materially interferes with tillage, and extreme stoniness makes crop production infeasible on a considerable acreage. Most of the soils are moderately to highly deficient in lime and plant nutrients, but they respond well to application of the deficient elements. Many of the soils are moderately to highly susceptible to erosion, and the proper choice and rotation of crops is very important. Second- and Third-class soils predominate in the association, but there is a considerable acreage of Fourth-class soils.

Practically all farms in this association are part-time. They are small, and the quantity of cropland is very small. Roads, houses, and other farm buildings cover a significant part of the better soils. Most of the cropland is used intensively, chiefly for subsistence crops.

JEFFERSON-MASADA-COBBLY ALLUVIUM

The Jefferson-Masada-cobbly alluvium association, which covers about 1 percent of the total county, is in two parts—one in the vicinity of Siam and the other near Hampton. The association occupies small covelike valleys (pl. 8, *C*). The relief is predominantly undulating to rolling, but some hilly areas are included. The association consists chiefly of colluvial soils, but there are some terrace and bottom soils. Gravelly Jefferson soils, by far the most extensive, occur on practically all the colluvial slopes. The small acreage of recent alluvium is chiefly cobbly alluvium (Hamblen soil material). Sequatchie soils are on the low terraces; Masada soils, on the high terraces.

Second-class soils cover about 75 percent of this association area; Third- and Fourth-class soils, most of the rest. Most of the soils are suited to tilled crops, but practically all contain enough stone or gravel to interfere with tillage. Some areas are so stony as almost to prohibit tillage. As a group, these soils are suited to more intensive use than those of the Jefferson-Allen-Sequatchie association. In general they are more fertile, and the problem of water control is not so great. They are, however, deficient in lime and most plant nutrients for high crop yields. They respond well to good management that includes proper and adequate fertilization. With adequate fertilization, practically all the common crops can be sucessfully grown.

Most of the farms in this association are of a general type, but there are also many part-time and subsistence farms.

JEFFERSON-ALLEN-TEAS

The Jefferson-Allen-Teas association, covering about 1 percent of the county, is widely distributed in small areas. It consists of thin colluvial deposits overlying purplish shale, some of which is exposed at the surface. The colluvial material, washed chiefly from Ramsey soils, is at the base of steep mountain slopes or spread out over the adjoining valley. The relief is predominantly hilly. Stony Jefferson and Allen soils are on the colluvial slopes, the Jefferson being much more extensive. Teas soils are on the slopes, chiefly the steeper ones not covered with colluvial material.

Fourth-class soils predominate in this association. The percentages of Second-, Third-, and Fifth-class soils are about equal, but their total is less than that of Fourth-class soils. Owing chiefly to the hilly to steep relief and stoniness, not much of the acreage is considered suitable for crops requiring tillage, and it is poor pasture land. Amendments are needed to establish and maintain even fair pasture.

Most farms are the part-time type; subsistence crops are grown on most of the crop-adapted soils. The hilly stony soils are mainly in pasture or idle.

DECATUR-DUNMORE-STONY LAND

About 1 percent of the county is in the Decatur-Dunmore-stony land association. It consists of rounded hills in the center of the valley of Stony Creek and is largely surrounded by the Jefferson-Allen-Sequatchie association. The Decatur soils, which are the most extensive, are intricately associated with Dunmore, Emory, and Hayter soils and with stony land types. Other less extensive soils are the Jefferson, Allen, and Teas.

A significant acreage of all the land classes is in this association, but there is more of the Second-class and less of the Fifth-class than of the others. Most of the dominant soils are well suited to a wide variety of crops and are relatively productive. Owing to the predominantly hilly relief and heavy subsoil, however, these soils are difficult to conserve when in crops that require tillage. As a group, they are very well suited to most pasture and hay crops, especially alfalfa and red clover. Difficulty of conservation makes the choice and rotation of crops important. Although relatively high in natural fertility, the soils respond well to the proper use of amendments. Emory and Hayter soils, although of small acreage, are well suited to intensive use and important to the agriculture of the association.

Most farms in this association are of the small general type, but many are part time and subsistence.

DUNMORE-FULLERTON-STONY LAND

The Dunmore-Fullerton-stony land association makes up about 4 percent of the county area. It occurs in less dissected parts of the limestone valley on prevailingly rolling to hilly land and has an irregular dendritic drainage pattern. Dunmore and Fullerton soils are most extensive, but there is a considerable acreage of stony land confined mainly to the steeper slopes. Other less extensive soils are the Clarksville, Groseclose, Emory, Greendale, and Lindside.

Second- and Third-class soils are on an estimated 60 percent of the area, and Fourth-class soils on most of the rest. The Dunmore and Fullerton soils are well suited to a wide variety of crops; but principally because they are difficult to conserve, they are not suited to intensive cropping. The Emory, Greendale, and Lindside soils are suited to intensive use and important to the agriculture of the farms on which they occur, even though they are of limited acreage. Most of the stony land types are fairly well suited to pasture. The choice and rotation of crops is important on the upland soils of this association. As a group these soils are comparatively fertile, yet they respond when amendments are properly used.

Most of the farms are the small general type. Tobacco and livestock products are important sources of income. Subsistence and part-time farms are fewer than in most of the other associations.

FULLERTON-STONY LAND-CLARKSVILLE

About 5 percent of the county is in the Fullerton-stony land-Clarksville association, which differs from the Dunmore-Fullerton-stony land association in being more highly dissected, in having more stony land, and in having less of Dunmore soils. Relief is predominantly hilly. Several streams traverse the area, and the first bottom and terrace soils along these streams greatly influence the agriculture. Fullerton and Clarksville soils and stony land types are on most of the uplands. Near the mountains, there is a significant acreage of Jefferson and Allen soils, especially on the areas of milder relief. Greendale soils are on most of the colluvial-alluvial areas. The Groseclose, Dunmore, Sequatchie, Lindside, Hamblen, Holston, and Nolichucky are less extensive soils.

An estimated 50 percent of the association consists of Fourth-class soils; most of the rest is largely Second- and Third-class soils, although 5 to 10 percent is Fifth-class soils. The Second- and Third-class soils—chiefly the Fullerton, Greendale, Allen, and Sequatchie—are well suited to a wide variety of crops. The stony land types and the steeper Fullerton, Clarksville, and Groseclose soils are fairly well suited to pasture but are very poor for crops. The association has a large acreage of soils suited to pasture but a very small one suited to intensive crop use.

A general type of farming, with tobacco and livestock products as important sources of income, is practiced by most farmers in this association. There are presumably more subsistence farms than in the Dunmore-Fullerton-stony land association.

STONY LAND-FULLERTON-CLARKSVILLE

The most highly dissected parts of the limestone valley area are in the Stony land-Fullerton-Clarksville association, which includes about 3 percent of the county area. The relief is prevailingly hilly and steep. Stony land types occupy a very large part of the association. Fullerton and Clarksville soils are the most extensive on the uplands, but there is also a small acreage of Dunmore and Groseclose soils. Greendale soils occupy most alluvial-colluvial areas. Small acreages of Emory, Nolichucky, Hiwassee, Masada, Dandridge, Allen, and Jefferson soils are also in this association.

The association consists predominantly of Fourth-class soils, although there is a considerable acreage of Third- and Fifth-class soils

and a small but significant acreage of Second-class soils. A large percentage of the soils are suitable for pasture, but only a very small percentage is suited to crops, especially to intensive crop production. Distribution, however, is such that almost every farm has at least a small acreage suitable for crops. Most of the crop-adapted soils are either on ridge crests or on colluvial-alluvial accumulations. The soils of this association vary considerably in natural productivity, but all respond well when deficiencies in plant nutrients are corrected.

Most of these farms are the part-time type. They are generally small, and the small acreage of crop-adapted soils is used intensively, chiefly for subsistence crops. A general type of farming, with livestock and tobacco as the chief sources of income, is practiced in the part of the association farthest from Elizabethton.

DANDRIDGE-HAMBLEN

The Dandridge, Hamblen, and Leadvale are the chief soils of the Dandridge-Hamblen association, which makes up about 3 percent of the county. The area is highly dissected by a fairly regular dendritic drainage system and characterized by narrow winding ridges and steep-walled V-shaped valleys. Steep and very steep Dandridge soils are on practically all the ridge slopes, and rolling or hilly soils on the narrow ridge crests. Leadvale soil is on most of the sloping alluvial-colluvial accumulations at the base of the steep upland slopes; Hamblen soil, on most of the nearly level flood plains.

Practically all of the uplands except the very steep areas are Fourth-class soils. The colluvial lands are mainly Third class; the bottom lands, Second class. Steep slopes, shallow depth, and high susceptibility to erosion make most of the Dandridge soils very poor for crops, but the relatively small acreages of Leadvale and Hamblen soils are suited to intensive use for suitable crops. The Hamblen soil has limited use suitability because it is susceptible to overflow and imperfectly drained, but is well suited to corn and many other feed and forage crops. Most farmers on this association practice subsistence farming. The relatively small acreage of Hamblen and Leadvale soils is used intensively for subsistence crops, but only a small part of the potential pasture land is used.

TEAS-LITZ-CAMP

Areas of the Teas-Litz-Camp association cover about 5 percent of the county and are widely distributed in the central part. Areas are in the vicinity of Keenburg, Hunter, Valley Forge, and near the junction of the Watauga and Elk Rivers. Typically, they consist of low rounded or domelike hills and have a hilly to steep relief. Some areas, however, especially those along the Elk River, occupy lower mountain slopes. The Teas and Litz soils are very intricately associated on most of the uplands; Camp soils are on the small alluvial-colluvial accumulations. Small acreages of Ramsey, Jefferson, and Allen soils are also in the association. Most of the colluvial and alluvial soils in the area along the Elk and Watauga Rivers are now covered by the Watauga Reservoir.

Fourth- and Fifth-class soils predominate. The hilly and steep Teas and Litz soils of the uplands are fairly well suited to pasture, but chiefly because of shallowness and steepness, they are poorly or very

poorly suited to crops. The relatively small acreage of Camp soils, however, is well suited to intensive cropping.

Most of the farms are either the part-time or subsistence type, with tobacco a very important source of cash income. Farms are generally small, and the acreage of soil suited to crops is limited.

RAMSEY-JEFFERSON-MATNEY

This large rough mountainous soil association—the Ramsey-Jefferson-Matney—consists chiefly of steep or very steep Ramsey soils. There is a very small acreage of Matney soil on the smoother mountain crests and a small acreage of Jefferson soils on the colluvial areas. These soils, however, are for the most part isolated by large areas of Fifth-class Ramsey soils; an estimated 95 percent of the association is Fifth-class soils. Practically all of the association is in forest, a large part of it national forest. Such use is presumably the best for most of the soils, although they are not productive of forest. This association covers about 26 percent of the county.

ASHE-TUSQUITEE-PERKINSVILLE

The rough mountainous Ashe-Tusquitee-Perkinsville soil association consists chiefly of steep and very steep Ashe soils and occupies about 28 percent of the county area. A small acreage of Perkinsville soils occurs on milder mountain crests, but it is largely isolated by large areas of the Ashe soils. A small acreage of colluvial and alluvial soils, possibly less than 5 percent of the association, is included. These are chiefly stony Tusquitee soils but include some Tate, Chewacla, and Congaree soils and Stony colluvium (Tusquitee and Jefferson soil materials).

About 90 percent of this association is estimated to be in Fifth-class soils, about 5 percent in Fourth-class soils, and 5 percent or less in Second- and Third-class soils. A significant acreage of the Second- and Third-class soils is covered by roads, houses, and other farm buildings. Because of isolated location, it is not feasible to use the Fourth-class soil to any important extent for pasture. The Tusquitee, Tate, Chewacla, and Congaree soils are suited to intensive use for crops, and some of the less steep and less stony Ashe soils are suited to pasture.

Practically all farms are of the subsistence or part-time type. Most of the acreage is in forest, largely nonfarm forest.

PORTERS-TUSQUITEE-BALFOUR

The rough mountainous Porters-Tusquitee-Balfour association differs from the Ashe-Tusquitee-Perkinsville association chiefly in including many small covelike areas (pl. 10). The association consists chiefly of steep or very steep Porters and, to a less extent, Ashe soils, but there is a significant acreage of Tusquitee soils and small acreages of Tate, Congaree, Chewacla soils, and Stony colluvium (Tusquitee and Jefferson soil materials). There is a small area of Balfour soils on the mountain crests, but it is mostly in very isolated positions. This association comprises about 9 percent of the county.

An estimated 85 percent of the total acreage is in Fifth-class soils, 5 to 10 percent in Fourth-class soils, and the rest in Second- and Third-class soils. Tusquitee, Tate, Chewacla, and Congaree soils of the colluvial and bottom lands are well suited to intensive use for crop

production, but their suitability is somewhat limited in most places by stoniness. A significant part of these crop-suited soils is also covered by roads and houses and other farm buildings. Some of the Porters soils, especially the less steep and less stony parts, are suited to pasture, but in many places they are inaccessible for such use.

Most farms are of the subsistence or livestock types. Many subsistence farms have livestock as an important source of income.

PERKINSVILLE-BALFOUR-MATNEY

About 1.5 percent of the total county area is covered by the Perkinsville-Balfour-Matney soil association, which occupies high mountain crests or plateaus. These plateaulike areas are moderately dissected, and the relief is prevailingly rolling to hilly but includes many steep slopes. Balfour, Perkinsville, and, to a less extent, Matney soils are on most of the rolling and nonstony hilly areas; Porters, Ashe, and Ramsey soils are on the stony hilly and steep areas. There are a few small colluvial areas consisting chiefly of Tusquitee and Tate soils.

About 25 percent of this association is Second- and Third-class soils, 40 percent Fourth-class, and the rest Fifth-class. The Balfour, Perkinsville, and Matney soils, which comprise practically all of the Second- and Third-class soils, are well suited to most of the common crops and are especially well suited to many vegetable and truck crops. The choice and rotation of crops and the proper use of amendments are important if crop yields are to be maintained or increased. The hilly and the nonstony steep Porters and Ashe soils included are fairly well suited to pasture, especially if properly fertilized.

Practically all farms in this association are the subsistence type. The crop-adapted soils are used fairly intensively for subsistence crops. Pasture is chiefly for the dairy cattle and work stock.

ADDITIONAL INFORMATION ABOUT CARTER COUNTY

INDUSTRIES

Carter County is in an industrial-agricultural region. Many rural families depend upon industry for part of their livelihood. The two rayon plants at Elizabethton, which employed about 7,000 workers in 1940, account for most off-the-farm work. They provide employment for residents of practically every community in the county. Two flour mills, numerous gristmills, and a few sawmills employ a small number of people.

Industry has had a noticeable effect on the agriculture of the county. It is responsible for the large number of part-time farms, and the additional income is reflected in better homes, farm buildings, and equipment.

TRANSPORTATION AND MARKETS

Two paved Federal highways and two State highways, either paved or graveled, cross the county. All parts of the county are penetrated by county or State roads that are well maintained and provide easily traveled routes to market. Some farms in the less productive districts are not on improved roads. In 1945, 2,386 farms were reported 0.2 mile or less from an all-weather road; 275, 0.3 to 0.5 mile from an all-weather road; 65, 0.6 to 0.9 mile; 195, 1 to 4 9 miles; and 129 farms, 5 miles or more from an all-weather road. Railway transportation is

provided by a spur of the Southern Railroad that connects with the main line at Johnson City in Washington County.

Elizabethton is the principal market and shipping point for agricultural products. Milligan College, Hunter, and Roan Mountain are other trading centers of much less importance. Johnson City, 9 miles from Elizabethton, provides a market for a considerable part of the agricultural products of Carter County.

FARM, HOME, AND COMMUNITY IMPROVEMENTS

All communities have schools and churches. School bus and rural mail delivery services extend to practically all parts of the county. Telephone services are available in most places, and electric power facilities have been extended greatly during recent years. Of the 3,127 farms in 1945, 776 reported 788 automobiles, 288 reported 302 motor-trucks, and 94 reported 95 tractors. Dwellings on 1,350 farms were reported as lighted by electricity, and 189 were reported as having telephones.

LAND-USE CHANGES

The great expansion in agriculture in Carter County took place before 1880, the year of the first complete agricultural census, although there have been several changes since that time. The percentage of land in farms had reached its peak by 1879, but the total amount of improved land continued to increase until about 1920. About 80 percent of the total county area was in farms in 1880, but the proportion steadily decreased to 45.5 percent by 1945. In the 65 years prior to 1945, the number of farms increased from 1,257 to 3,127, but the average farm size decreased from 140 acres to 33. The rural population increased from 10,019 in 1880 to 31,678 in 1950.

CROPS

The most important crops in the county are corn, wheat, burley tobacco, potatoes, lespedeza, red clover, and alfalfa. Less important crops are oats, rye, barley, buckwheat, sorghum, and vegetables. The crops grown have not changed greatly in the past 65 years, but there have been a few changes in their acreage and relative importance. Most important are the increases in acreage of barley and tobacco and of hay and forage crops (including lespedeza and alfalfa) and the decreases in wheat, oats, corn, rye, buckwheat, vegetables, and sorghum. These changes can be noted from the 1919–44 figures in table 28, which gives the acreage of the principal crops and number of bearing fruit trees and grapevines.

CORN

Corn, the most important crop in the county, is grown on practically all farms. In 1944 the average yield of corn was 28.6 bushels an acre. Corn is grown on nearly all of the soils commonly tilled, but a larger part of the soils of the bottom lands and colluvial lands is used for it, and yields on these lands are considerably higher than the average for the county (pl. 11, *A*). Fertilizer is applied on many of the upland soils used for corn, but only a limited quantity is used on the bottom lands. Most corn is fed on the farms where it is grown.

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TABLE 28.—*Acreage of the principal crops and number* [1] *of bearing fruit trees and grapevines in Carter County, Tenn., in stated years*

Crop	1919	1929	1939	1944
	Acres	*Acres*	*Acres*	*Acres*
Corn for grain	15, 346	10, 593	9, 213	8, 283
Corn for silage and forage	5, 523	115	71	54
Winter wheat threshed	9, 913	3, 372	2, 559	2, 274
Oats threshed	2, 899	521	578	439
Oats unthreshed	(2)	1, 362	854	1, 535
Barley threshed	60	116	574	443
Rye threshed	358	161	128	88
Buckwheat threshed	408	158	150	(2)
All hay	11, 285	10, 872	11, 097	11, 396
Lespedeza	(2)	(2)	4, 572	4, 997
Timothy and/or clover	8, 594	8, 964	4, 123	2, 222
Alfalfa	70	163	318	639
Annual legumes cut for hay	913	924	310	172
Grains cut green	27	51	513	81
Other cultivated grasses	1, 482	739	1, 187	3, 229
Wild grasses	199	31	74	56
Potatoes	552	845	728	596
Sweetpotatoes	87	154	93	83
All other vegetables	123	121	296	296
Tobacco	56	101	536	661
Soybeans [3]	518	839	437	440
Cowpeas [3]	27	72	31	16
Sorghum cane for sirup	680	(2)	56	(2)
	Number	*Number*	*Number*	*Number*
Apples ... trees	61, 118	54, 392	41, 084	39, 764
Peaches ... do	22, 119	13, 608	7, 441	2, 686
Pears ... do	1, 614	1, 418	1, 082	1, 162
Plums and prunes ... do	2, 243	2, 411	2, 037	942
Cherries ... do	6, 889	7, 668	4, 242	5, 195
Grapevines	4, 296	3, 083	4, 504	4, 497

[1] Number of fruit trees and grapevines in 1944 are is for ages.
[2] Not reported.
[3] Grown alone; does not include acreages grown for green manuring.

WHEAT

Although the acreage in wheat has decreased in recent years, the average acre yield has increased steadily, reflecting the wider use of commercial fertilizer. At present, most of the wheatland is fertilized with 150 to 400 pounds of commercial fertilizer containing phosphate and usually potash. The acre yield of 6 bushels in 1879 had risen to 13 in 1944.

All wheat is sown in fall, and most of it is grown on the more productive soils of uplands, terraces, and old colluvial lands (pl. 11, *B*). Some is grown on soils of the bottom lands that are not subject to frequent overflow, but yields are lower and losses are greater because of lodging. Most of the wheat is consumed on the farms; the rest is sold.

OATS, RYE, BARLEY, AND BUCKWHEAT

Most of the oats, rye, barley, and buckwheat is grown in the Great Valley part of the county on much the same soils as wheat. Much of the early acreage of oats was cut green for hay. The recent decrease in acreage results partly because legumes and other hay crops have replaced oats. Oats and barley are generally threshed and used on the farm. Rye is used largely for winter pasture and as a winter cover crop but is occasionally harvested for grain. Buckwheat, relatively important in the mountain area, has never occupied a large acreage, and most of it is used on the farm.

HAY AND FORAGE CROPS

The total acreage in hay and forage crops has not changed much in the past 25 years. Lespedeza, the chief single hay crop, has developed mainly during the last two decades, whereas the acreage in timothy and clover has decreased. Both alfalfa and red clover are becoming important hay crops. Red clover is grown either alone or mixed with such grasses as timothy, redtop, and orchard grass; alfalfa is usually grown alone. Most of the alfalfa and red clover are grown on the more productive well-drained soils, whereas lespedeza is grown on soils varying widely in fertility and drainage. Lime and phosphate are required for the successful growth of red clover and alfalfa, but lespedeza is grown without amendments. Some crimson clover is grown, chiefly as a winter cover crop. Soybeans and cowpeas are important annual legumes grown either as regular or emergency hay crops; their acreages fluctuates from year to year, depending on use. Practically all hay and forage crops are fed on the farm on which they are grown.

TOBACCO

Recently burley tobacco has become important as the only strictly cash crop; it is the chief source of income on many farms. A small patch is now grown on most farms. Much labor and considerable skill are required for its successful growth, and eastern Tennessee is noted for the quality of its tobacco. Most of it is grown on well-drained permeable soils, such as the Emory, Greendale, and Camp (pl. 11, *C*). The crop, however, is grown on a wide variety of soils with varying degrees of success. In 1944, 917,874 pounds were produced on 661 acres, or an average of 1,389 pounds an acre.

Burley tobacco is cut late in summer and is hung in barns to be air-cured and prepared for market. In December or January it is auctioned at tobacco warehouses, chiefly at the nearby Johnson City or Greeneville markets.

FRUITS AND VEGETABLES

Fruits and vegetables are produced chiefly for home use, although some are sold at local markets. Potatoes, cabbage, green beans, and tomatoes are the principal vegetables grown for market. In greater part they are grown in the mountain area. Many other vegetables—onions, sweetpotatoes, cucumbers, lima beans, lettuce, sweet corn,

cantaloups, and watermelons—are grown for home use. Apples, peaches, cherries, plums, and pears are the chief fruits. Small acreages of strawberries and raspberries are grown.

PERMANENT PASTURE

According to the 1945 census, there were 45,983 acres of land pastured in Carter County. Of this total, 5,471 acres were in cropland pasture, 9,691 acres in woodland pasture, and the rest in permanent pasture. About 60 percent of the permanent open pasture is in the mountain area, chiefly on soils such as Porters and Ashe but to lesser extent on Tusquitee and Tate soils. Mountain pasture consists of mixtures of bluegrass, orchard grass, redtop, timothy, and white clover.

In the valley part of the county permanent pasture is largely confined to soils that are too steep or too stony to be easily cultivated or are very shallow over bedrock. Some soils of the bottom lands that are too poorly drained for cultivation are also in permanent pasture. Most of these pastures are on Dandridge, Teas, Litz, or the rolling and hilly stony land types, and their quality varies with management. Bluegrass is the chief pasture plant. Where soil amendments have been used, pasture usually consists of bluegrass and clovers; in many untreated areas, broomsedge is the dominant plant. There is a trend toward better pasture management, and many farmers are now using lime and phosphate.

AGRICULTURAL PRACTICES

Agricultural practices vary somewhat according to differences in soils, patterns of soil distribution, lay of the land, and size of farms. Modern machinery is generally used on the larger farms in the smooth or rolling areas. During the last decade tractors have replaced many horses and mules in the smoother areas. In 1945, there were 95 tractors and 302 motortrucks reported by 94 and 288 farms, respectively. Many of these did work on neighboring farms as well as on the home farm. Much of the tillage in the hilly and steep areas and on small farms is done with one-horse implements or by hand labor.

Small grains are generally harvested with grain binders, although small combines are being introduced where comparatively large acreages of grain are grown. Most of the corn is harvested by hand, and where winter crops are to be sown, the corn is cut before it is ripe enough to be picked. The ears are gathered late in fall and early in winter. Most of the small grains, such as wheat, oats, barley, and rye, are planted in fall and harvested during June or July. Grasses and legumes are sown either in fall or in spring. Corn is usually planted in April or May.

Systematic rotation of crops is not practiced by many farmers, although many kinds of crops are grown. The particular needs of the farmer or the general fertility level of the field usually determine the crop to be grown. However, a crop rotation consisting of corn, small grain, and hay or pasture is used on many of the better farms.

The use of lime and commercial fertilizer has increased greatly during recent years. Application of phosphatic fertilizers and lime on pasture and hay crops is becoming a common practice, partly as a

A, Excellent crop of corn on Congaree and State soils.
B, Harvesting wheat on Nolichucky and Holston soils.
C, Burley tobacco on Emory soils.

A, Second-growth stand of Virginia pine and redcedar becoming established on abandoned areas of severely eroded Dunmore soil.
B, Black locust on Rough gullied land (Ashe and Porters soil materials).
C, Seven-year-old planting of white pine on Tusquitee soils.

result of the Government-sponsored agricultural programs. Most of the commercial fertilizer purchased is ready-mixed. Manure is commonly applied to the cropped land, chiefly to the tobacco crop. Most of the soils need lime, which is being supplied in increasing quantities.

LIVESTOCK

The number of livestock on farms in stated years is shown in table 29.

TABLE 29.—*Number of livestock and beehives on farms in Carter County, Tenn., in stated years*

Livestock	1920	1930	1940	1945
Horses	2, 255	1, 401	[1] 1, 345	1, 681
Mules	905	571	[1] 364	262
Cattle	9, 673	8, 454	[1] 7, 710	9, 568
Sheep	1, 197	3, 266	[2] 1, 203	553
Goats	6	8	[3] 17	37
Swine	6, 613	3, 296	[3] 2, 951	4, 091
Chickens	79, 315	54, 447	[3] 53, 322	[3] 72, 807
Other poultry	4, 857		[3] 1, 056	([4])
Beehives	1, 961	1, 794	1, 068	([4])

[1] Over 3 months old, Apr. 1.
[2] Over 6 months old, Apr. 1.
[3] Over 4 months old, Apr. 1.
[4] Not reported.

WORK STOCK

Work animals are chiefly horses, Percheron being the principal breed. In 1945 there were about 6 horses to each mule, and an average of only 0.6 work animal a farm. Most of the replacements are raised on farms in the county.

CATTLE

Of the 9,568 cattle in 1945, 5,011 were cows and heifers over 2 years old, kept mainly for the production of milk. Although there were 26 dairy farms in 1945, the greater part of the dairy products were produced on subsistence, part-time, and general types of farms. The dairy cattle are principally grades of Jersey and Guernsey breeds. Dairying is done mainly in the valley part of the county southwest of Elizabethton, but one or two dairy cows are kept on most farms to supply milk, butter, and cream for household use. Usually dairy products are sold to specialized dairies that have delivery routes in the urban areas. Not enough dairy products are produced to meet demands within the county.

Most beef cattle are grades of Hereford, Shorthorn, or Aberdeen Angus. Beef cattle are distributed throughout the county, but the larger herds are in the valley area southwest of Elizabethton. Beef cattle and veal calves are principally sold to local buyers and shipped to outside markets.

SWINE, SHEEP, AND GOATS

Poland China, Chester White, Duroc, and Hampshire are the most popular breeds of hogs. Many are raised for home use, and some are sold to local buyers and shipped to packing plants in Knoxville. Consumption of pork in the county exceeds production.

The number of sheep has decreased from 1920 to 1945. The Hampshire is the most common breed. Lambs and wool are generally sold to local buyers. There were 37 goats reported in 1945, the greatest number for any census year.

POULTRY

Poultry, chiefly chickens, is an important source of income on most farms. White Leghorn, Rhode Island Red, and Plymouth Rock are the most common breeds. Chickens and eggs are used chiefly on the farm but some are sold locally. Only a few turkeys and ducks are raised.

TYPES AND SIZES OF FARMS

In 1945, 568 farms received their major source of income from field crops, 103 from livestock, 30 from vegetables harvested for sale, 26 from dairy products, 15 from poultry and poultry products, 6 from fruits and nuts, and 6 from forest products. There were 2,267 subsistence farms, or those on which farm products raised are used mainly by the farm household; 76 general farms; 27 farms that sold no products; and 3 unclassified farms.

Census figures in 1945 report 860 farms under 10 acres in size; 1,103 farms, 10 to 29 acres; 549 farms, 30 to 49 acres; 427 farms, 50 to 99 acres; and 188 farms, 100 acres or more.

FARM TENURE

In 1945, full owners operated 2,736 farms; part owners, 190; managers, 1; and tenants, 200. The proportion of tenancy was 6.4 percent in 1944.

In the common landlord-tenant agreement, the landlord furnishes the tenant with a house, work animals, and seed; the tenant furnishes the labor. Fertilizer costs are usually divided according to the sharing of the crop. The tobacco crop is commonly shared equally between the landlord and the tenant, but the corn and small-grain crops are usually shared two-thirds by the landlord and one-third by the tenant. Tenants who supply labor, work animals, implements, seed, and fertilizer receive two-thirds of all crops, including tobacco. Little land is rented for cash, and definite cash rental prices have not been established.

FORESTS [11]

The first settlers found the area embodying Carter County an unbroken forest abounding with elk, buffalo, bear, deer, turkeys, and many small animals (*4*). Approximately 65 percent of the land area of Carter County is still in forest, and of this, 23 percent is farm woodland; 25 percent, private nonfarm woodland; and 52 percent, public forest (*13*). Based on the number of farms reporting woodland in the 1945 United States census, the average size of woodland per farm was 17 acres.

Of the total area in forest, 24 percent is classified as saw timber, 18 percent as cordwood, and 58 percent as below cordwood. The saw timber volume totals 116,075 M board feet, of which 71,848 M board feet are hardwood and 44,227 M board feet are softwood (conifers).

[11] Prepared by G. B. Shivery, extension forester, University of Tennessee.

The present volume an acre amounts to 800 board feet, and the average annual growth per acre is 150 board feet.[12]

There are now 15 permanent wood-using industries and 13 portable mills in the county.[13] In 1942 there were 21 active sawmills,[14] and the production of lumber totaled 1,812 M board feet of softwood and 3,279 M board feet of hardwood. In 1912 there were 16 sawmills, 6 of which cut more than 1,000 M board feet per year; in 1909, there were 35 sawmills, one of which sawed more than 5,000 M board feet of lumber annually (*11*, *7*). Chestnut extract wood and hardwood pulpwood continue to be moved by trucks to loading points and markets outside the county.

FOREST TYPES

There is some correlation between soil associations and broad forest types, but the correlation is not perfect. The correlation between the forest type and the physiographic divisions of the county is somewhat closer. Differences in elevation, as well as soil, have influenced the forest types within the county.

The timber-producing area consists of the following forest types and proportion of distribution (*12*).

	Percent		*Percent*
Yellow pine-hardwoods	36	Hemlock-white pine	3
Upland hardwoods	24	Hemlock-hardwoods	2
Oak-chestnut	24	Yellow pine	1
White pine-hardwoods	5	Spruce-fir	1
Northern hardwoods	3	Cedar-hardwoods	1

The extensive yellow pine-hardwoods forest type and the restricted pure yellow pine forest type are largely confined to the quartzite mountains or the Ramsey-Jefferson-Matney soil association. The Dandridge-Hamblen soil association in the valley area also has this kind of forest. Yellow pine-hardwoods includes stands of mixed yellow pine and hardwoods in which the percentage of all pines ranges between 25 and 75 percent of the total dominant and codominant stems. Virginia pine occupies the dry slopes and ridges generally below 2,500 feet and pitch pine the ridges, dry flats, and slopes recurrently burned by fire at elevations ranging from 2,000 to 5,000 feet. Hardwoods in this forest type include Southern red, blackjack, black, scarlet, white, and post oaks; blackgum; and hickories. Table-mountain pine occurs sparsely at the higher elevations. Jefferson and Allen soils in the moist ravines and hollows, however, support a more vigorous forest growth, with such species as yellow-poplar, white pine, Northern red oak, red maple, cucumbertree, and hemlock displacing this dry-site type. The Matney soil of the ridge tops supports, instead of yellow pine-hardwoods, species characteristic of the upland hardwoods type, with occasional white pine in the mixture.

The upland hardwoods forest type includes such species as white, Northern red, Southern red, black, scarlet, post, and chestnut oaks; yellow-poplar; blackgum; hickories; yellow locust; sourwood; and

[12] 1945–46 appraisal, State Conservation Department and the American Forestry Association. [Processed.]

[13] See footnote 12.

[14] Forest survey, Southeastern (formerly Appalachian) Forest Experiment Station.

dogwood. This type covers most of the valley part of the county. It is on the Decatur-Dunmore-stony land, Dunmore-Fullerton-stony land-Clarksville, and Stony land-Fullerton-Clarksville soil associations.

The small areas of the cedar-hardwoods forest type are largely on Limestone rockland or stony land types.

The granitic mountain section of the county, which includes the Porters-Tusquitee-Balfour, Ashe-Tusquitee-Perkinsville, and Perkinsville-Balfour-Matney soil associations, has fairly uniform soil conditions but varies greatly in elevation and consequently in climatic conditions. Three broad forest types—oak-chesnut, hemlock-white pine, and northern hardwoods—occur within the area, each of which is confined to a fairly definite range in elevation. Considerable overlapping of the forest types with that of the zone above and below is to be expected, however.

The oak-chestnut forest is the most extensive type in the granitic mountain section. It is generally below an elevation of 3,500 feet, but some areas extend up to 4,000 feet. Northern red oak, white oak, and dead chestnut are dominant, but some white pine is usually included.

A small area of white pine-hardwoods forest also occurs within the elevation range of the oak-chestnut type. White pine comprises from 25 to 75 percent of the total dominant and codominant stems. This forest type occupies coves, mountain slopes, high valleys, and flat ridge tops in the northeastern part of the county. Also at this elevation is a small area of the upland hardwoods forest type northwest of Roan Mountain village, which varies from the general forest type of the valley chiefly in the dominant and codominant species. Characteristic species are yellow-poplar, Northern red oak, and white oak associated with yellow locust, red maple, black birch, cucumbertree, white pine, hemlock, and other moist-site species.

An area of hemock-white pine forest is east of the headwaters of Laurel Fork. It is in cool locations, ravines, and on northern slopes at elevations up to 4,000 feet.

The hemlock-hardwoods forest type, which is closely associated with the upland hardwoods area, consists of yellow-poplar and associated species. Hemlock comprises 25 to 75 percent of the total dominant and codominant stems.

The northern hardwoods forest type occurs between 3,500 and 5,000 feet elevation, particularly in the vicinity of Roan Mountain. Beech, sugar, mountain, and striped maples, buckeye, yellow and black birches, serviceberry, and associated species are characteristic.

The spruce-fir forest type, which is above 5,000 feet in elevation, is limited in area, largely to Roan Mountain. Red spruce and balsam fir predominate, but they are associated with yellow birch, striped maple, mountain-ash, and mosses interwoven with oxalis. *Rhododendron catawbiense* likewise appears at this elevation. The spruce-fir forest type merges into balds; the grassy bald, the rhododendron bald, and the alder bald have been identified (*3*).

FOREST MANAGEMENT

Forest has important indirect benefits aside from production of wood products, especially on land subject to erosion. A protective

layer of forest litter absorbs the impact of rain, thus preserving the tiny pores and channels between the soil particles as the water makes its way downward. Fungi, bacteria, and tiny animals that consume the litter and each other create a dark-brown colloidal substance called humus, which, when carried down into the mineral soil by percolating water, improves both physical structure and fertility. This litter and humus has, in addition, great ability to absorb water directly. Porosity is further achieved by the channels left after the decay of dead roots. The soil-binding function of the surface roots is also highly beneficial; the densest root network is found in the lower parts of the well-developed layers of litter.

Results obtained at the erosion station near Statesville, N. C., show a loss of only 0.002 ton of soil and 0.06 percent loss of rainfall from virgin woodland (*16*). A companion wooded plot burned twice yearly shows runoff of 11.5 percent and soil loss of 3.08 tons an acre, as compared with 0.06 percent runoff and 0.001 ton an acre soil loss on the unburned plot. Similar experiments at Zanesville, Ohio, for a 9-year period show the runoff as 20.6 percent on cultivated land, 13.8 percent on pasture, and 3.2 percent on woodland. The soil loss per acre was 17.8 tons on cultivated land, 0.1 ton on pasture, and 0.01 ton on woodland (*17*).

Both erosion control and maximum absorption, therefore, result from complete forest cover. Old-growth forested soil is more porous and absorbs water much more rapidly than cultivated soil. Where the forest cover is properly maintained, second-growth forested soil does not lose its porosity unless it is overgrazed or the litter is destroyed by fire (*1*)

Prevention of fires, control of grazing, and use of proper cutting and planting practices are necessary for satisfactory forest production. These practices are needed for maintenance of the maximum soil porosity required for erosion control.

FIRE PREVENTION

Most of the fires in the county are the result of carelessness in burning brush, but incendiarism and careless smokers are also responsible for many. Forest protection, consisting mostly of fire prevention, has been conducted for about 20 years. The national forest land receives adequate protection from fire, and protection of the remaining 69,747 acres of privately owned forest land is the responsibility of the State. Two national forest fire towers, located on White Rocks Mountain and on Holston High Knob, report fires detected on private land, although they were erected for the protection of the Cherokee National Forest. The fire-control organization maintained at present by the State Division of Forestry consists of a mobile crew of five men on duty for 2 fall months and 3 spring months. A State-owned tower on Doe Mountain in Johnson County is an important part of the lookout system and cooperates with the Holston High Knob tower and with a lookout on Buck Ridge manned by the United States Forest Service.[15]

[15] Information provided by Division of Forestry, Tennessee Department of Conservation, and the U. S. Forest Service.

CONTROL OF GRAZING

Indiana experiments show that woodland grazed under intensities of 2, 4, or 6 acres an animal unit, without supplementary feeding, resulted in serious deterioration of the animals over a 6-month season (*5*). The timber-producing capacity, in addition, is gradually destroyed by the repeated browsing, and the natural regeneration of the stand is prevented. Compaction of the soil, disturbance of humus, and resulting interference with soil porosity lessen water absorption.

CUTTING PRACTICES

In the Cherokee National Forest harvesting methods and cultural practices aim toward preserving desirable species on the land in a condition that will allow vigorous growth in the immediate future.[16] Cutting practices within the county, however, are not conducive to sustained timber production. Changes must be made to halt the progressive deterioration of the forest resources. A greater value should be placed on the potential crop, or saw-timber, tree.

The cut-over woodland contains much cull timber that hinders the development of potential crop trees. Farm woodland can be materially improved by using such inferior trees for fuel and other minor farm needs or by cutting them for pulpwood or chestnut extract wood. Such improvement can be made by systematic cutting and use of crooked, short bushy-topped, unsound, or slow-growing trees and reserving the straight tall well-crowned ones that are free from defect for growth into crop timber.

PLANTING

Second-growth stands on eroded and abandoned land consist largely of Virginia pine, particularly in the valley area. Varying percentages of redcedar may be with the Virginia pine, especially on the heavy soils derived from limestone material (pl. 12, *A*), and pitch pine volunteers on some areas. Virginia pine is a prolific producer of seed and can utilize dry and less favorable sites at relatively low elevations. The cone-bearing trees perform a valuable service in the natural dissemination of seed, healing over severely eroded areas on which planting would be expensive.

At times, however, it may be necessary to resort to planting forest trees, particularly on the Fourth- and Fifth-class soils that are severely eroded. Essential advance preparation is needed for successful planting, and every location presents a specific problem. Preparation of the land may include breaking and mulching galled areas, building simple low brush dams in gullies, and plowing contour furrows.

Species should be selected that suit the characteristics of the particular soil. Degree of erosion, elevation, and exposure should be considered. Although many farmers prefer planting locust (pl. 12, *B*) because they need fence posts, pine is usually better adapted to the severe growing conditions encountered on lands designated for forest use.

In the valley section landowners are encouraged to do the land preparation and planting, using free forest-tree seedlings provided by

[16] Reappraisal survey, U. S. Forest Service, 1945. [Processed.]

the Tennessee Valley Authority. Under this arrangement, through the help of county agricultural agents, a total of 174 acres have been planted.[17] White pine and black locust comprise practically all of the 264,640 trees planted. In addition, a total of 701 acres were planted in the Cherokee National Forest during 1934 and 1935, consisting largely of white pine but containing some yellow-poplar [18] (pl. 12, *C*).

Rough gullied land (Dandridge soil material) and Rough gullied land (Dunmore and Fullerton soil materials) need reforesting. Black locust does well in gullies in the moist well-aerated soil material accumulated behind the simply constructed check dams. Many areas need black locust for the silting basins. The trees respond well to cultivation and to phosphate fertilizer, measures that give a protective vegetative cover more promptly. Sheet-eroded areas between gullies need shortleaf pine or, on the most unfavorable sites, Virginia pine.

Rough gullied land (Ashe and Porters soil materials) and cleared areas of very steep soils in the mountain section should be planted to white pine. Soils for which white pine is indicated, and which probably should be reforested on most farms, include the eroded steep phases of Masada gravelly silt loam, Ashe stony loam, Porters stony loam, Jefferson stony fine sandy loam, and Allen stony loam. Other soils—as the eroded steep phases of Porters loam, Ashe loam, and Ashe sandy loam—unless very well managed, probably should be planted to white pine.

Soils of the valley area that should be reforested, unless a very high level of management is practiced, are the severely eroded steep phases of Decatur silty clay loam and Dunmore silty clay loam; and the eroded steep phases of Teas-Litz shaly silty clay loams, Teas shaly silty clay loam, Fullerton loam, Fullerton silt loam, Dunmore silty clay loam, Decatur silty clay loam, and Danridge shaly silt loam. Shortleaf pine is well suited to most areas, but Virginia pine should be used on dry barren south and west exposures. Where check dams are used in gullies black locust can be successfully used.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which that material accumulated and has since existed; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material (*15*).

Climate and vegetation are the active factors of soil genesis. They influence the parent material and change it from an inert mass to a body that has a definite morphology. The effects of climate and vegetation on parent material are to varying degrees affected by the modifying influence of relief, which, in turn, affects drainage, aeration, the quantity of water that percolates through the soil, the rate of natural erosion, the vegetation, and exposure to sun and wind. The

[17] Information obtained from Forestry Relations, Tennessee Valley Authority.
[18] Information obtained from U. S. Forest Service.

nature of parent material also affects the results of the forces of climate and vegetation and is important in determining internal soil conditions and the kinds of vegetation that will grow. Finally, time is involved in the changes that take place, and age becomes a factor of soil genesis, for it reflects the degree to which the soil has developed into a body that is in equilibrium with its environment. The degree of such development depends not only on time, but also on the rate at with the forces of climate and vegetation act, that rate being affected by the factors of relief and parent material.

The factors of soil genesis are so closely interrelated in their effects on the soil that few generalizations can be made regarding the influence of any one unless conditions are specified for the other four. They are so complex in their interrelation that many of the processes that take place in the development of soils are unknown.

FACTORS OF SOIL FORMATION

PARENT MATERIAL

The parent materials of the soils of Carter County may be considered in two broad classes: (1) Material residual from the weathering of rocks in place and (2) material transported by water or gravity and laid down as unconsolidated deposits of clay, silt, sand, and large fragments. Residual materials are related directly to the underlying rocks from which they were derived; and transported materials are related to the soils or rocks from which they washed or fell.

The parent materials formed in place consist of the residuum of igneous, sedimentary, and metamorphic rocks. The properties of these rocks are strongly reflected in many of the characteristics of the soils that have developed from them. The igneous rocks include granite; the sedimentary rocks include limestone, dolomitic limestone, sandstone, conglomerate, and shale; and the metamorphic rocks include quartzite and slate. Geologically, the rocks are very old—the sedimentary rocks were formed in the early part of the Paleozoic era and the igneous rocks in the Archeozoic era (*9*). Most of the rock formations are folded and faulted and generally have a decided dip.

The upland soils of the county have developed from residual materials and are generally associated with particular rock formations or parts of rock formations. The Decatur soils are chiefly from the weathered materials of high-grade limestone of the Shady formation. The Dunmore, Groseclose, Fullerton, and Clarksville soils are associated with the dolomitic limestone of the Knox formation; some Dunmore and Fullerton soils are from the Honaker and Shady limestone formations. Almost all the Dandridge soils are from the weathered materials of the Athens shale, although some derived from Nolichucky shale are included. The Teas and Litz soils are associated with the Watauga shale formation. The Ramsey and Matney soils are associated with Erwin quartzite, Hampton shale, and the Unicoi formation. Ashe, Perkinsville, and some of the Porters soils are derived from material weathered from Beech and Cranberry granites. Burton, Balfour, and some of the Porters soils are from Roan gneiss.

The nature of the transported rock materials is reflected in some of the properties of the soils derived from them. Soils of the Hiwassee, Masada, Altavista, Roanoke, Congaree, Chewacla, Buncombe, State, Tusquitee, and Tate series are derived from transported materials that consists mainly of granite or gneiss and products of their decomposition. Soils of the Lindside, Ooltewah, Emory, and Greendale series are derived from transported materials that consist mainly of limestone or dolomitic limestone. Nolichucky, Holston, Jefferson, Allen, Sequatchie, Staser, and Hamblen soils are formed from transported materials consisting chiefly of sandstone, quartzite, and shale or products of their decomposition. The Hayter soils are formed from materials washed from sandstone, quartzite, or shale but include some material from limestone. The Leadvale and Camp soils are from materials washed chiefly from upland soils underlain by shale.

Although a fairly consistent relation exists between the kinds of parent materials and some of the properties of soils, other soil properties, especially those of regional significance from the standpoint of soil genesis, cannot be correlated with kinds of parent material and must be attributed to other factors.

CLIMATE

Carter County has a humid temperate climate (*14*). The valley part of the county has long warm summers, short mild winters, and relatively high rainfall; the mountain areas have cool summers, lower average temperatures throughout the year, and heavier precipitation (including considerably more snow). The high rainfall throughout the county favors intense leaching of soluble materials and colloidal materials downward in the soil. The soil is frozen for only short periods, especially in the valley area, and to only shallow depths, which further intensifies the degree of weathering and translocation of materials.

The general climate of the valley is relatively uniform, but small local differences exist because slope and exposure of land vary. On south- and west-facing slopes the average daily and annual temperature of the soils is somewhat higher than on the north- and east-facing slopes. Soil temperatures are also higher on the steeper slopes. Average moisture content of the soils is less on the south and west slopes than on the north and east slopes.

These local moisture and temperature conditions affect the length of time that the soil is frozen and the growth of plants on it. The differences are small but significant and are possibly responsible for some of the local variations in soils derived from similar parent material. For the valley section as a whole, however, the differences in climate are not great enough to account for the broad differences existing among the soils. Climate is the cause of some of the outstanding characteristics many of the soils have in common and, on the other hand, accounts for some of the broad differences that exist between the soils of the valley and those of the mountains.

BIOLOGICAL FORCES

Trees, shrubs, grasses, other herbaceous plants, micro-organisms, earthworms, and various other forms of plant and animal life on and

in the soil are active in soil-forming processes. The nature of the changes these various biological forces bring about depends, among other things, on the kinds of life and the life processes peculiar to each.

The kinds of plants and animals that live on and in the soil are determined by environmental factors, including climate, parent material, relief, age of the soil, and associated organisms. The influence of climate is most apparent, though not always most important, in determining the kinds of higher plants that grow on the well-drained well-developed soils. In this way climate exerts a powerful indirect influence on the morphology of soils. Climate and vegetation acting together are the active factors of soil genesis.

A general oak-hickory-chestnut forest was on most of the well-drained well-developed soils, although locally there may have been large percentages of pine in the forest stand (see section on Forests). A spruce-fir forest predominates at elevations above 5,500 feet. A few areas at this higher elevation also had a natural vegetative cover of grasses, alders, or rhododendron. There were probably differences in the density of stands, the relative proportion of species, and the associated ground cover. Taking the area as a whole, however, the forest appears to have been relatively uniform. Except at high elevations, it is doubtful that any of the marked differences in characteristics among the well-drained well-developed soils are the direct result of differences in vegetative cover.

Most of the trees are moderately deep to deep feeders on plant nutrients in the soil. They are chiefly deciduous and shed their leaves annually. The leaves range considerably among species in content of various plant nutrients, but usually the quantity of bases and phosphorus returned to the soil is high as compared to that in leaves of coniferous trees. In this way, essential plant nutrients are returned to the upper part of the soil from the lower part and retard the depleting action of percolating water.

Much organic material is added to the soil in the form of dead leaves, roots, and entire plants. Most of it is added to the A horizon, where it is acted upon by micro-organisms, earthworms, and other forms of life and by direct chemical reactions. Such materials decompose rapidly because of favorable temperature and moisture conditions, favorable character of the organic material itself, and presumably favorable micropopulation of the soil. Organic material does not accumulate on well-drained sites in the valley part of the county to the extent that it does in the cooler mountain regions.

Little is known of the micro-organism, earthworm, and other population of the soils in the area, but their importance is probably equal to that of the vegetation on the soil.

AGE

Where the parent materials have been in place a long time and have not been subject to extreme conditions of relief or of the parent material itself, the soils that have developed have the characteristics of zonal soils. In places where the parent material has been in place only a short time, as in the case of recently transported materials, the soils have poorly defined or no genetic horizons. These soils are young and have few or none of the properties of zonal soils and are called azonal soils. On some nearly level areas where both internal

and external drainage are restricted or where geologic erosion is very slow, soils whose materials have been in place a long time have certain well-developed profile characteristics that zonal soils do not have. Such soils are associated geographically with the zonal soils and are called intrazonal soils.

RELIEF

The relief of soils ranges from nearly level to very steep. On some steep areas where the quantity of water that percolates through the soil is relatively small, and where the large quantity of water that runs off the soil and the rapid rate of runoff contribute to relatively rapid geologic erosion, the soils are young. The materials are constantly renewed or mixed, and the changes brought about by vegetation and climate may be so slight that the soils are essentially AC soils.

Rock formations, aside from being the source of parent material, have contributed to differences among soils through their effects on relief. The rock formations in most of Carter County are very old and folded and faulted (*9*, *2*). The present relief is probably largely a product of geologic weathering and erosion of these formations. The higher lands are capped by the more resistant rocks; the valleys are underlain by the less resistant (*6*).

Streams flowing between the ridges and mountains generally have steeper gradients than those in the valleys. As a result of faster stream cutting and greater relief from the floors to the dividing ridge crests, most of the soils of the ridges and mountains have steeper slopes. In this way, the character of the rocks has contributed indirectly to the properties of some soils through relief.

The internal drainage of soils of nearly level relief in the limestone areas is exceptionally good because water drains through caverns and crevices in the sharply dipping rocks. This good subterranean drainage in the areas underlain by limestone counteracts the effects gentle relief usually has on drainage, and the nature of the parent rock therefore dominates local differences among the well-developed well-drained soils derived from residual materials and subject to similar forces of climate and vegetation.

CLASSIFICATION OF SOILS

Soils of each of the three broad orders—zonal, azonal, and intrazonal—may be derived from similar kinds of parent materials. Within any one of these classes in this area major differences among soils appear to be closely related to differences in the kinds of parent materials from which the soils were derived. The thickness of soils developed from residual materials lying over the rock from which they were derived is a partial result of the resistance of the rock to weathering, the volume of residue after weathering, and the rate of geologic erosion. The chemical and physical nature of the parent material modifies the rate and direction of chemical changes that result from climate and vegetation and also exerts a pronounced influence on the kinds of vegetation.

The soil series of Carter County are classified according to order and great soil group in table 30. The source and kinds of parent materials and the relief, climate, and age of each soil are given to show genetic relations.

TABLE 30.—*Classification of the soil series of Carter County, Tenn., into higher categories, and factors that have contributed to the differences* [1] *in soil morphology*

Great soil group and series	Relief	Parent material	Climate [2]	Time [3]
Red-Yellow Podzolic:			Warm temperate rainy climate with—	
Red Podzolic subgroup:		Residuum from—		
Decatur	Rolling to steep	High-grade limestone	Hot summers	Long.
Dunmore	do	Slightly clayey dolomitic limestone.	do	Do.
Fullerton	do	Dolomitic limestone	do	Do.
Allen	Undulating to steep	Colluvium from sandstone and stone.	do	Do.
		Old alluvium from—		
Hiwassee	Undulating to hilly	Granite and gneiss	do	Do.
Nolichucky	Rolling to hilly	Sandstone and shale	do	Do.
Yellow Podzolic subgroup:		Residuum from—		
Clarksville	do	Cherty dolomitic limestone	do	Do.
Groseclose	do	Clayey dolomite limestone	do	Do.
		Old alluvium from—		
Holston	do	Sandstone and shale	do	Do.
Masada	Undulating to steep	Granite and gneiss	do	Do.
Altavista	Undulating	do	do	Do.
		Old colluvium from—		
Leadvale	Rolling	Shale	do	Medium to long.
Jefferson	Undulating to steep	Sandstone and shale	do	Do.
Sequatchie	Undulating	Old alluvium from sandstone, shale, and some limestone.	do	Do.
Gray-Brown Podzolic:		Residuum from—		
Balfour	Rolling to hilly	Granite and gneiss	Cool summers	Long.
Perkinsville	do	do	do	Do.
Matney	Rolling	Quartzite, conglomerate, and sandstone.	do	Do.

Tusquitee	Undulating to hilly	Old colluvium from— Granite and gneiss	do	Medium to long.
Tate	Rolling to hilly	do	do	Do.
State	Nearly level to undulating	Old alluvium from granite and gneiss.	Hot summers	Do.
Hayter	Undulating to rolling	Old colluvium from shale, sandstone, and limestone.	do	Do.
Lithosolic Gray-Brown Podzolic:				
Ashe	Hilly to very steep	Residuum from— Granite and gneiss	Cool summers	Short to medium.
Porters	do	do	do	Do.
INTRAZONAL				
Planosols:				
Roanoke	Nearly level to undulating	Old alluvium from— Granite and gneiss	Warm temperate rainy climate with— Hot summers	Very long.
Half Bog:				
Burton	Rolling to hilly	do	Cool summers	Medium to long.
AZONAL				
Lithosols:				
Ramsey	Hilly to very steep	Residuum from— Quartzite, conglomerate, and sandstone.	Warm temperate rainy climate with— Cool summers	Short to medium.
Dandridge	Rolling to very steep	Calcareous shale	Hot summers	Do.
Teas	Hilly to very steep	Interbedded shale and limestone.	do	Do.
Litz	Rolling to very steep	do	do	Do.
Alluvial:				
Staser	Nearly level	Recent alluvium from— Sandstone, quartzite, and shale.	do	Very short.
Hamblen	do	do	do	Do.

See footnotes at end of table.

TABLE 30.—*Classification of the soil series of Carter County, Tenn., into higher categories, and factors that have contributed to the differences* [1] *in soil morphology*—Continued

AZONAL—Continued

Great soil group and series	Relief	Parent material	Climate [2]	Time [3]
Alluvial—Continued		Recent alluvium from—	Warm temperate rainy climate with—	
Congaree	Nearly level	Granite and gneiss	Hot summers	Very short.
Chewacla	do	do	do	Do.
Wehadkee	do	do	do	Do.
Buncombe	do	do	do	Do.
Lindside	do	Limestone	do	Do.
Ooltewah	Depressional	do	do	Do.
Emory	Undulating to rolling	do	do	Short to medium.
Greendale	do	do	do	Do.
Camp	Undulating to hilly	Limestone and shale	do	Do.

[1] Inasmuch as the vegetation is relatively uniform it cannot account for the broad differences in the soils and therefore is not given.

[2] See the section on Climate for further discussion.

[3] This refers to the length of time that the material appears to have been in place, as evidenced by the soil profile.

ZONAL SOILS

The well-drained well-developed (zonal) soils of this county have been formed under relatively similar conditions of climate and vegetation. Climate and vegetation have had the maximum influence and the minimum of modification has been caused by relief and age. As a result, the soils developed from various kinds of parent materials are alike in many properties common to soils of zonal extent; therefore, they can be called zonal soils. Zonal soils are defined as "those great groups of soils having well-developed soil characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms" (*15*).

In the virgin conditions, the soils have a layer of organic debris on the surface in varying stages of decomposition. All have a dark A_1 horizon and an A_2 horizon lighter in color than either the A_1 or the B. The B horizon is generally uniformly colored yellow, brown, or red and is heavier textured than the A_1 or A_2. The C horizon varies in color and texture among the different soils but is usually light red or yellow, mottled with gray or brown.

Analyses of samples of several comparable soils from Jefferson County, Tenn., may be expected to apply to these soils. With depth, the silica content decreased and the alumina and iron contents increased. The content of organic matter was moderate in the A_1 hozizon, less in the A_2 horizon, and very low in the B and C horizons. The soils were low in bases and phosphorus within the solums. In general, the ignition loss was low, indicating a low content of tightly held water. The reaction was medium, strongly, or very strongly acid throughout the solum. Usually the quantity of silt decreased and the quantities of clay and colloid increased with depth from the A_1 horizon through the C horizon. The colloid content of the B horizon was much higher than that of the A_2 horizon.

The zonal soils are subdivided into Red-Yellow Podzolic soils and Gray-Brown Podzolic soils in Carter County.

Red-Yellow Podzolic Group

The Red-Yellow Podzolic great soil group is divided into two subgroups—Red Podzolic and Yellow Podzolic.

RED PODZOLIC SOILS

The Red Podzolic soils are a group of zonal soils having thin organic and organic-mineral layers over a yellowish-brown leached layer that rests upon an illuvial red horizon, developed under a deciduous or mixed forest in a warm-temperate moist climate (*15*). The soil-forming processes involved in their development are laterization and podzolization. The Red Podzolic soils in Carter County are the Decatur, Dunmore, Fullerton, Allen, Hiwassee, and Nolichucky.

These soils have the common characteristics of Red Podzolic soils, and apparently all have developed under relatively similar conditions of climate and vegetation. They are well drained, and although they range somewhat in degree of maturity, all are sufficiently old to have at least a moderately well developed Red Podzolic soil profile. They range from level to steep, but differences among the soil profiles are

probably not due primarily to differences in slope. There are marked differences among the parent materials of the various soils, many of which can be correlated with differences among soil profiles.

Decatur Series

The Decatur soils are the darkest red and have the deepest solum of the soils in the valley section. They have developed from high-grade limestone and dolomite that are apparently a little higher in insoluble impurities, especially silica, than those underlying the Dunmore soils. The Decatur soils are on rolling to steep areas of the uplands. Rock outcrops are few, except in severely eroded places. This series has the darkest A horizon of the well-developed soils in the valley, which indicates a higher content of organic matter; and it is the most productive. It probably supported the most luxuriant vegetation, which resulted in its darker A horizon and friable surface soil and subsoil and tended to inhibit surface erosion.

Profile description:

A_2. 0 to 12 inches, dark-brown friable heavy silt loam with a moderately well-developed medium crumb structure.

B_1. 12 to 20 inches, brown to slightly reddish-brown friable silty clay loam with a weakly developed fine to medium blocky structure.

B_2. 20 to 44 inches, reddish-brown or dark-red moderately plastic silty clay with a well-developed medium to coarse blocky structure; structure faces are glossy and darker than the crushed material.

B_3. 44 to 70 inches, reddish-brown moderately to strongly plastic silty clay having larger and less distinct structural particles than horizon above.

C. 70 to 90 inches +, brown to yellowish-brown plastic silty clay lightly splotched with red, brown, yellow, and gray.

Dunmore Series

The Dunmore soils are formed from slightly clayey to moderately high-grade limestone and dolomitic limestone that are apparently higher in clay than those from which the Decatur soils are derived. In some places, the limestone contains thin lenses of shaly material. The parent material is relatively low in insoluble impurities. The soils have developed on rolling to steep relief, chiefly under a deciduous forest vegetation. They probably supported a luxuriant vegetation before they were cleared, which partly accounts for the brown color of the A horizon. The major differences between the Decatur and Dunmore series are probably directly or indirectly the result of differences between the parent materials.

Profile description:

A_1. 0 to 2 inches, dark grayish-brown friable silt loam with a weak, soft, medium crumb structure; apparently high in organic matter.

A_2 2 to 12 inches, grayish-brown friable heavy silt loam with a weak medium crumb structure.

B_1. 12 to 16 inches, yellowish-brown moderately friable silty clay loam with a weak medium blocky structure.

B_2. 16 to 40 inches, yellowish-brown moderately to strongly plastic silty clay with a well-developed medium blocky structure; structure faces are glossy and reddish.

C. 40 to 60 inches +, brownish-yellow plastic silty clay splotched with gray and brown; a few small shale fragments are in various stages of decomposition; the uneven rock floor is at a depth of about 5 feet.

Fullerton Series

Soils of the Fullerton series are developed from materials residual chiefly from dolomite or dolomitic limestone; these are high in insoluble materials, chiefly silica. The silica occurs largely in the form of chert, but, locally, calcareous sandstone beds have contributed to the parent materials.

These soils commonly occupy higher positions, are deeper, less fertile, less erosive, more cherty, and have steeper slopes than the Dunmore and Decatur soils that have similar but not the same kind of parent materials. They are less susceptible to erosion and have a greater volume of residual material left from weathering of the parent rocks than the Dunmore and Decatur; the result apparently is a thicker mantle of unconsolidated rock material over the bedrock. This mantle protects the bedrock from rapid weathering and, together with the fact that dolomite weathers more slowly than limestone, may largely account for the higher position Fullerton soils occupy and their resultant steeper slopes. These soils are medium to strongly acid throughout the profile.

Profile description:

A_1. 0 to 2 inches, dark-gray silt loam stained dark with organic matter.

A_2. 2 to 10 inches, brownish-gray very friable silt loam.

A_3. 10 to 14 inches, brownish-yellow to grayish-yellow friable heavy silt loam with a weak soft medium crumb structure.

B_1. 14 to 22 inches, brownish-yellow or yellowish-brown friable silty clay loam with a weak medium blocky structure.

B_2. 22 to 40 inches, yellowish-red slightly plastic silty clay loam with a well-developed medium blocky structure; crushed material is reddish yellow.

C. 40 to 60 inches +, reddish-yellow moderately plastic clay streaked and splotched with gray and brown; a few chert fragments; bedrock at a depth of 10 feet or more.

Allen Series

The Allen soils have developed from parent materials that consist of colluvial and local alluvial materials washed mainly from uplands underlain by sandstone, quartzite, conglomerate, and shale with some limestone influence. They have undulating to steep slopes. The physical condition of the parent material enables free movement of percolating waters, and the supply of bases is sufficiently low to promote rapid development of a mature genetic profile. Most of the Allen soils are some distance from the slopes from which the major part of their parent materials was washed. The faces of the mountain slopes are being eroded away and are slowly retreating so that colluvial benches are left some distance out in the valley. As a result, the Allen soils do not receive annual increments of colluvial material. Reaction is medium to strongly acid.

In many places, Jefferson soils with Yellow Podzolic profiles are developed on what, superficially at least, appears to be parent materials similar to those of Allen soils. The differences between the two soils can be accounted for at least in part by differences in parent material and age. In Carter County practically all of the Allen soils are underlain at variable depths by limestone or calcareous shale bedrock and are in such position that they are influenced by waters that

flow over or through limestone materials. In contrast, practically all of the Jefferson soils are underlain by acid rocks, and percolating waters flow only through noncalcareous materials.

Profile description for Allen series:

A_1. 0 to 1 inch, dark-gray loose fine sandy loam stained dark with organic matter.
A_2. 1 to 9 inches, grayish-brown to brown friable loam.
B_1. 9 to 18 inches, yellowish-brown to yellowish-red friable light clay loam with a weak medium blocky structure.
B_2. 18 to 30 inches, red to brownish-red moderately friable sandy clay loam with a well-developed medium blocky structure.
B_3. 30 to 45 inches, brownish-red to yellowish-red friable sandy clay loam having a less distinct structure than the horizon above.
C. 45 to 60 inches +, yellowish-red friable sandy clay loam streaked and splotched with yellow and gray and containing many fragments of partly weathered gray and red sandstone and quartzite.

Hiwassee Series

The Hiwassee are well-developed soils formed from very old deposits of alluvium. This alluvium consists mainly of the residue weathered from granite and gneiss but in most places includes admixture of material from sandstone, quartzite, shale, and slate. The relatively high fertility of these soils, together with favorable moisture conditions, appears to have encouraged a heavy forest growth that resulted in relatively high organic-matter content in the upper horizon. In many ways, the Hiwassee soils resemble the Decatur, but they are generally deeper, more friable, and have cobblestones throughout the profile. Reaction is medium to strongly acid throughout.

Profile description:

A_1. 0 to 2 inches, dark grayish-brown loose loam stained dark with organic matter.
A_2. 2 to 12 inches, brown friable heavy silt loam with a moderately well-developed medium crumb structure.
B_1. 12 to 18 inches, reddish-brown friable silty clay loam with a moderately well-developed blocky structure.
B_2. 18 to 36 inches, reddish-brown to yellowish-red moderately friable heavy silty clay loam with a well-developed medium blocky structure.
B_3. 36 to 60 inches, yellowish-red to reddish-yellow friable clay loam with structure less distinct than in the horizon above.
C. 60 to 96 inches, gravelly or cobbly clay loam that is mainly reddish-yellow but splotched with yellow and gray.

Nolichucky Series

Nolichucky soils have formed from old alluvium that consists mainly of residue from quartzite, sandstone, shale, and slate, but in most places includes a small admixture of granite and limestone materials. The soils have developed on a rolling to hilly relief under a deciduous forest vegetation. The moderately low fertility has apparently resulted in poor forest growth and in a low content of organic matter in the upper horizon. These soils are highly leached and strongly acid.

Profile description.

A_1. 0 to 1 inch, medium-gray loose fine sandy loam stained with organic matter.
A_2. 1 to 8 inches, yellowish-gray very friable fine sandy loam.
B_1. 8 to 18 inches, brownish-yellow or light yellowish-brown friable heavy sandy loam.

B_2. 18 to 32 inches, reddish-yellow moderately friable clay loam with a moderately well developed medium blocky structure.
B_3. 32 to 48 inches, yellowish-red firm sandy clay loam with some brownish-yellow streaks.
C. 48 inches +, reddish-yellow firm sandy clay loam profusely streaked and splotched with gray and yellow.

YELLOW PODZOLIC SOILS

Yellow Podzolic soils are a group of zonal soils having thin organic and organic-mineral layers over a grayish-yellow leached layer that rests on a yellow horizon (*15*). These soils have undulating to steep relief and were developed under a forest vegetation that consisted mainly of deciduous trees with a considerable admixture of pines in some places. There may have been more pines and a somewhat less luxuriant and different kind of undergrowth on the Yellow Podzolic soils than on the Red Podzolic soils of the area. Climatic conditions on the soils of the two groups were apparently similar. The parent materials were derived from cherty dolomitic limestone and colluvial and terrace materials.

The causes of the development of the pronounced color differences between the Yellow Podzolic and the Red Podzolic soils are not known. It appears, however, that the Yellow Podzolic soils are generally associated with parent materials either lower in bases or less well drained internally than are the materials parent to the Red Podzolic soils.

The Clarksville, Groseclose, Holston, Masada, Altavista, Leadvale, Jefferson, and Sequatchie are Yellow Podzolic soils.

Clarksville Series

The Clarksville soils are closely associated geographically with the Fullerton soils, but they are developed from materials residual from the weathering of dolomitic limestone that is much more siliceous than that from which the Fullerton soils are derived. The limestone is weathered to a great depth, and apparently the residuum has lost most of its bases. The residuum is strongly acid and has a low base-exchange capacity, indicating that the siliceous part dominates the parent material.

The Clarksville soils developed under a forest that was largely deciduous. They are generally less subject to erosion, more cherty, and deeper over bedrock than the Fullerton soils. The thick covering of disintegrated rock protects the unweathered rock and may account in part for the high positions Clarksville soils occupy and the resultant steepness of some of the slopes. These soils are not so susceptible to erosion as are the other soils derived from dolomitic limestone in the county, a condition that may be partly responsible for the thickness of weathered material over bedrock. The soils are strongly acid.

Profile description:

A_1. 0 to 1 inch, gray loose silt loam stained dark with organic matter.
A_2. 1 to 10 inches, light-gray to yellowish-gray very friable cherty silt loam.
A_3. 10 to 16 inches, grayish-yellow friable cherty heavy silt loam.
B_2. 16 to 30 inches, yellow to brownish-yellow moderately plastic cherty silty clay loam having a moderately well developed medium nutlike structure.

C. 30 to 60 inches +, brownish-yellow moderately plastic cherty silty clay loam streaked and splotched with gray; contains thin layers of partly decomposed yellow shale in lower part.

Groseclose Series

The soils of the Groseclose series are closely related to those of the Dunmore series but differ in having a lighter colored more eluviated surface and a lighter colored thinner subsoil. The Groseclose soils are derived from dolomitic limestone that leaves a slatelike argillaceous material when weathered. The material, especially in this county, is more siliceous than that of the Dunmore soils. These soils are heavier, more plastic, thinner, and somewhat darker than the Clarksville, and their parent material is more argillaceous and less siliceous. Reaction is medium to strongly acid.

Profile description:

A_1. 0 to 1 inch, dark-gray loose silt loam stained dark with organic matter.
A_2. 1 to 7 inches, gray friable silt loam.
A_3. 7 to 10 inches, brownish-gray moderately friable heavy silt loam.
B_2. 10 to 28 inches, yellowish-brown to brownish-yellow moderately to strongly plastic silty clay with a well-developed coarse blocky structure.
C. 28 to 48 inches +, reddish-yellow strongly plastic silty clay streaked and splotched with yellow and gray; contains partly decomposed yellow shale particles.

Holston Series

The Holston soils have developed from old stream alluvium derived chiefly from sandstone, quartzite, and shale. They have rolling and hilly relief, good external drainage, and adequate but slightly restricted internal drainage. They appear to be very old and in some places approach the Planosols in soil properties.

Like the other Yellow Podzolic soils described, they are developed from materials that are low in bases, a condition that likely promotes rapid soil formation. Slightly restricted internal drainage may also have contributed to the yellow color that is in contrast to the reddish color of the well-drained Nolichucky soils developed from what appears to be similar materials. These soils are strongly to very strongly acid throughout the profile.

Profile description:

A_1. 0 to 1 inch, medium-gray loose fine sandy loam stained dark with organic matter.
A_2. 1 to 8 inches, gray very friable fine sandy loam.
A_3. 8 to 12 inches, yellowish-gray friable fine sandy loam.
B_2. 12 to 30 inches, yellow or slightly brownish-yellow moderately firm but friable clay loam faintly splotched with gray in the lower part and having a weak fine to medium blocky structure.
C. 30 to 48 inches +, yellow moderately compact sandy clay loam highly mottled with gray and brown.

Masada Series

Soils of the Masada series are formed from old alluvium that consists mainly of the residue weathered from granite and gneiss, but in most places it contains an admixture of material from sandstone, quartzite, shale, and slate. The relatively high fertility and favorable moisture conditions have encouraged a heavy forest growth, which resulted in a relatively high content of organic matter in the upper layers. Parent materials are similar to those of the Hiwassee soils,

and the differences between the soils is apparently due to the slightly restricted drainage of the Masada series. Masada soils are medium to strongly acid.

Profile description:

A_1. 0 to 2 inches, dark grayish-brown loose silt loam stained dark with organic matter.

A_2. 2 to 12 inches, grayish-brown friable silt loam.

B_2. 12 to 36 inches, yellowish-brown, slightly reddish in upper part, friable silty clay loam with a moderately well developed medium blocky structure.

C. 36 inches +, brownish-yellow or yellow moderately friable sandy clay loam splotched with gray.

Altavista Series

The imperfectly to moderately well drained Altavista soil is derived from old alluvium washed largely from uplands underlain by granite and gneiss, although in most places it contains materials washed from uplands underlain by sandstone, quartzite, shale, and slate. This soil is on nearly level to undulating stream terraces and has slow external drainage and restricted internal drainage. Differences between this and the Masada soils, which are formed from similar materials, are due chiefly to differences in drainage. The reaction is medium to strongly acid.

Profile description:

A_1. 0 to 2 inches, dark-gray mellow silt loam stained dark with organic matter.

A_2. 2 to 10 inches, yellowish-gray or grayish-yellow friable silt loam.

B_2. 10 to 30 inches, brownish-yellow to yellow moderately friable silty clay loam with a weakly developed medium nut structure; gray and brown splotches common in the lower part.

C. 30 inches +, pale-yellow friable silty clay loam highly mottled with gray, yellow, and brown.

Leadvale Series

The Leadvale soil is on slopes, fans, and benches at the foot of upland slopes. Geographically it is closely associated with the Dandridge soils and its parent materials consist chiefly of colluvium and local alluvium from the Dandridge. Locally, the Litz soils have contributed some material. The Leadvale soil has gently sloping to sloping relief, but it has restricted internal drainage because of the silty character of the parent materials. It was formed under a hardwood forest in climatic conditions similar to those under which other zonal soils were developed.

In some places, the Leadvale soil receives increments of soil material at frequent intervals and is a young soil with weakly developed or indistinct profiles. In most places, however, the profiles are sufficiently developed to justify its classification as Yellow Podzolic. This soil is medium to strongly acid. Numerous small shale fragments are on the surface and throughout the profile.

Profile description:

A_1. 0 to 2 inches, dark-gray mellow silt loam stained dark with organic matter.

A_2. 2 to 10 inches, yellowish-gray friable silt loam with a weak coarse crumb structure.

B_2. 10 to 26 inches, brownish-yellow to yellow moderately friable silty clay loam with a weak medium blocky structure.
C. 26 to 42 inches +, yellow friable silty clay loam mottled with gray, yellow, and brown.

Jefferson Series

The soils of the Jefferson series are on foot slopes and benches at the base of mountain slopes. Their parent materials are local alluvium and colluvium washed chiefly from the Ramsey soils on the adjoining uplands. The Jefferson soils have undulating to steep relief and are well drained. In most places they have developed under mixed forests of hardwoods and pines. The climate was essentially that of the other zonal soils of the valley area.

Some Jefferson soils receive frequent increments of soil material and are young. They have little profile development and would be properly classified as Alluvial soils. The materials, however, are low in bases and easily eluviated, and, in most places, soils with young Yellow Podzolic profiles have developed.

Profile description:

A_1. 0 to 1 inch, medium-gray loose fine sandy loam stained with organic matter.
A_2. 1 to 8 inches, grayish-yellow very friable stony fine sandy loam.
B_2. 8 to 24 inches, grayish-yellow to brownish-yellow friable stony sandy clay loam.
C. 24 to 48 inches +, brownish-yellow friable stony sandy clay loam mottled with gray, red, and brown.

Sequatchie Series

The soils of the Sequatchie series are on low stream terraces or second bottoms along the larger creeks and rivers. They have developed from parent materials similar to those of the Staser series with which they are generally closely associated geographically. Relief is nearly level to gently sloping. They were developed under a hardwood forest and under climatic conditions similar to those of the other zonal soils of the valley area. Some of the materials from which the soils are derived, however, were so recently deposited that only weak profile development is apparent.

Profile description:

A_1. 0 to 2 inches, dark grayish-brown loose fine sandy loam containing a relatively large quantity of organic matter.
A_2. 2 to 12 inches, grayish-brown or light-brown very friable loam.
B_2. 12 to 30 inches, yellowish-brown to brownish-yellow friable light clay loam having a poorly developed medium nut structure.
C. 30 to 42 inches +, brownish-yellow very friable sandy loam splotched with gray, yellow, and brown.

Gray-Brown Podzolic Group

Gray-Brown Podzolic soils and lithosolic Gray-Brown Podzolic soils compose the Gray-Brown Podzolic group in this county.

Gray-Brown Podzolic Soils

Gray-Brown Podzolic soils comprise 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. These soils are developed under deciduous forest in a tem-

perate 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 A_1 horizon and a light grayish-brown or grayish-yellow A_2 horizon; and 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 it seldom exceeds 4 feet. Podzolization is the main process in the development of these soils (*15*).

The causes of the development of Gray-Brown Podzolic soils rather than Red Podzolic or Yellow Podzolic soils as in the valley part of the county, appear to be due largely to differences in climate, although there are also differences in vegetation and parent materials. Gray-Brown Podzolic soils are largely confined to the mountain areas that have a temperate moist climate with cool summers.

The Balfour, Perkinsville, Matney, Tusquitee, Tate, State, and Hayter are Gray-Brown Podzolic soils in this county.

Balfour Series

The Balfour soils have developed from materials somewhat similar to those of the Perkinsville. The granite and gneiss parent rock of the Balfour was probably somewhat less acid. The soils are browner and less yellow than the Perkinsville, possibly because there is more iron oxide in their parent material. The relatively high fertility of Balfour soils, together with their favorable moisture conditions, encouraged a heavy forest growth that resulted in a relatively high content of organic matter. These soils occupy rolling and hilly mountain crests, in contrast to the hilly to very steep slopes of the Porters soils that are formed from similar materials. The Porters soils differ from the Balfour in not having well-developed eluvial and illuvial horizons. Balfour soils are medium to strongly acid; the forest vegetation apparently does not bring bases to the surface in sufficient quantity to prevent the soil from becoming acid, although the surface horizons are less acid than the rest of the soil.

Profile description:

A_1. 0 to 2 inches, dark-brown loose loam having a soft coarse crumb structure.

A_2. 2 to 6 inches, brown or grayish-brown very friable loam with a weak medium crumb structure.

A_3. 6 to 10 inches, light-brown friable loam.

B_2. 10 to 30 inches, yellowish-brown friable clay loam with a weak fine blocky structure.

B_3. 30 to 40 inches, brownish-yellow very friable light clay loam with a poorly developed medium blocky structure.

C. 40 to 48 inches, grayish-yellow friable clay loam splotched with gray; contains numerous partly disintegrated rock fragments.

Perkinsville Series

Perkinsville soils are developed from the residuum of low-micaceous, acidic, mainly light-colored, igneous or metamorphosed igneous rocks. Like the Balfour soils these soils occupy high mountain crests or plateaus. They are less fertile than the Balfour and apparently supported a poorer forest growth; as a result the surface layers are lower in organic matter. The differences in the soils are presumably chiefly

due to differences in the granite and gneiss parent materials. The Perkinsville soils are usually from lighter colored more acid rocks and are strongly acid.

Profile description for Perkinsville series:

A_1. 0 to 2 inches, medium-gray loose loam stained with organic matter.
A_2. 2 to 8 inches, brownish-gray very friable loam with a weak fine crumb structure.
A_3. 8 to 12 inches, grayish-yellow friable loam.
B_2. 12 to 28 inches, brownish-yellow to yellow friable clay loam having a weak medium blocky structure.
B_3. 28 to 36 inches, yellow to grayish-yellow friable clay loam containing some partly disintegrated rock fragments.
C. 36 to 48 inches, yellowish-gray clay loam splotched with gray and yellow and containing numerous partly disintegrated rock fragments.

Matney Series

The Matney soil resembles the Perkinsville and Balfour soils in most morphological characteristics and in genesis, but it has parent material weathered from sandstone, quartzite, conglomerate, shale, and slate. It is at high altitudes on mountain crests or plateaus and has developed under a moist temperate climate with cool summers. It is probably less fertile and more acid than the Perkinsville soils.

Profile description:

A_1. 0 to 1 inch, gray loose loam stained dark with organic matter.
A_2. 1 to 8 inches, yellowish-gray very friable loam with a weak fine crumb structure.
A_3. 8 to 12 inches, grayish-yellow friable heavy loam.
B_2. 12 to 24 inches, brownish-yellow friable clay loam with a weak medium blocky structure.
C. 24 to 36 inches, yellow friable clay loam splotched with gray and containing numerous partly disintegrated rock fragments.

Tusquitee Series

The soils of the Tusquitee series resemble those of the Balfour series in most significant morphological characteristics. They occupy colluvial positions and have formed from materials washed from adjacent slopes. In this county, most of the material has washed largely from Porters and, to a less extent, from Ashe soils. Depth to bedrock is generally greater, and moisture conditions are more favorable for heavy vegetative growth than on the Balfour soils. The forest apparently included a larger percentage of sugar maple, tuliptree, basswood, and birch. The Tusquitee soils have thicker dark surface layers and are more variable in degree of profile development. In some places, the soils receive frequent increments of soil material and are young soils with little profile development. Reaction is medium acid.

Profile description for Tusquitee series:

A_1. 0 to 4 inches, dark grayish-brown loose loam strained dark with organic matter.
A_2. 4 to 12 inches, brown friable loam with a well-developed medium crumb structure.
B_2. 12 to 32 inches, yellowish-brown friable clay loam with a moderately well developed medium granular structure.
B_3. 32 to 40 inches, brownish-yellow friable light clay loam that is lighter in texture and contains more stones than the above horizon.
C. 40 to 60 inches, brownish-yellow to yellow stony clay loam splotched with gray and light yellow.

Tate Series

The Tate soils have developed from colluvial and local alluvial material accumulated at the base of slopes or in fans along small streams. The materials have washed largely from Ashe and, to a less extent, Porters soils. Tate soils differ from the Tusquitee chiefly in being lighter colored and less fertile, and in having a lower organic-matter content. They have these differences largely because they are derived from lighter colored parent material and have slightly restricted drainage. Reaction is medium to strongly acid.

Profile description:

A_1. 0 to 3 inches, dark grayish-brown loose loam stained dark with organic matter.

A_2. 3 to 12 inches, grayish-brown very friable loam.

B_2. 12 to 28 inches, light yellowish-brown friable clay loam with a weak medium blocky structure; lower part lightly splotched with gray.

C. 28 to 48 inches +, pale-yellow friable clay loam splotched with gray and yellow.

State Series

The State soil is similar in many morphological characteristics to the Tusquitee soils, but it differs in being derived from a more general type of alluvium and in being on low terraces rather than on colluvial areas. It has formed under conditions of climate and vegetation similar to those for the Tusquitee. Areas have developed on low stream terraces from materials washed chiefly from uplands underlain by granite and gneiss, but small quantities of materials from quartzite, shale, sandstone, and conglomerate are admixed in most places. It is a medium acid soil.

Profile description:

A_1. 0 to 3 inches, dark grayish-brown loose loam stained dark with organic matter.

A_2. 3 to 12 inches, grayish-brown very friable loam.

B_2. 12 to 28 inches, yellowish-brown friable clay loam with a weak medium blocky structure.

B_3. 28 to 40 inches, brownish-yellow light clay loam.

C. 40 to 60 inches, brownish-yellow to grayish-yellow very friable sandy loam that is stratified and consists of variable coarse-textured materials.

Hayter Series

Soils of the Hayter series have developed from old colluvium and local alluvium. The colluvium was derived from slopes underlain mainly by noncalcareous sandstone or quartzite and consists of sandstone fragments and other rock debris. In most areas, it contains some calacareous material, limestone or calcareous shale, or is influenced by drainage waters from such materials. Most of the colluvial materials have been in place long enough for the development of the normal Gray-Brown Podzolic soil profile. Hayter soils differ from the associated Jefferson in having a much browner profile and apparently in containing a much larger quantity of decomposed organic matter. They differ from the Allen soils in having a darker surface layer and a brown rather than a red subsoil. Reaction is medium acid.

Profile description:

A_1. 0 to 3 inches, dark grayish-brown loose loam stained dark with organic matter.

A_2. 3 to 14 inches, grayish-brown very friable loam with a weak soft crumb structure.
B_2. 14 to 28 inches, yellowish-brown friable silty clay loam with a weak medium blocky structure.
B_3. 28 to 36 inches, brownish-yellow friable clay loam.
C. 36 to 60 inches, brownish-yellow to yellow friable clay loam or sandy clay loam containing numerous sandstone and quartzite pebbles and cobblestones.

LITHOSOLIC GRAY-BROWN PODZOLIC SOILS

Most areas of the lithosolic Gray-Brown Podzolic soils have a weakly developed Gray-Brown Podzolic profile that is not sufficiently developed throughout to justify considering them as fully representative of that zonal group.

The Ashe and Porters soils comprise this group in Carter County.

Ashe Series

The Ashe soils are on hilly to very steep mountain uplands. They have formed from loamy or sandy parent materials weathered from low-micaceous, acidic, mainly light-colored igneous and metamorphosed igneous rocks similar to those underlying the Perkinsville soils. Their native vegetation consisted of a hardwood forest mixed in places with pine and hemlock. Drainage is excessive. The soil material is removed by geologic erosion almost as rapidly as it is formed; consequently the Ashe soils lack profile development or have thin weakly developed profiles.

Profile description:

A_1. 0 to 2 inches, dark-gray loose loam stained dark with organic matter.
A_2. 2 to 10 inches, grayish-yellow friable stony loam with a weak fine crumb structure.
B_2. 10 to 30 inches, pale yellowish-brown or yellowish-gray friable heavy stony loam.
C. 30 to 40 inches, yellowish-gray very stony loam highly mottled with gray.
D. 40 inches +, granite bedrock.

Porters Series

The Porters soils have formed from materials somewhat similar to those of the Ashe soils, although the parent rock was probably somewhat less acidic. The parent rocks are chiefly dark-colored granite and gneiss. These soils are browner and less yellow than the Ashe soils, probably owing to more iron oxide in the parent material, and they are more fertile. They apparently support a more luxuriant vegetation and consequently have darker surface layers.

Profile description:

A_1. 0 to 3 inches, dark grayish-brown loose loam stained dark with organic matter.
A_2. 3 to 10 inches, grayish-brown or brown very friable stony loam with a moderately well developed soft crumb structure.
B_2. 10 to 28 inches, yellowish-brown friable stony loam.
C. 28 to 40 inches, brownish-yellow to pale-yellow stony loam or clay loam containing a large quantity of gray partly disintegrated rock fragments.
D. 40 inches +, granite bedrock.

INTRAZONAL SOILS

Intrazonal soils are defined as soils "with more or less well-developed soil characteristics that reflect the dominating influence of some local

factor of relief, parent material, or age over the normal effect of the climate and vegetation" (*15*). The properties of such soils in this area are generally the result of level relief influenced greatly by the character of the parent material and the kinds of vegetation that grow in such environments. The Planosols and Half Bog soils are intrazonal soils.

Planosol Group

Planosols are an intrazonal group of soils with eluviated surface horizons underlain by B horizons more strongly illuviated, cemented, or compacted than associated normal soils. They have developed upon nearly level upland surface under grass or forest vegetation in a humid or subhumid climate (*15*). In Carter County only the Roanoke series has been designated a Planosol. It has nearly level or slightly depressional relief and is poorly drained. The B horizon is more dense or compacted than are those of most zonal soils, but its degree of development varies.

Climatic conditions were similar to those under which the zonal soils developed, but internally the soil is more moist and less well aerated than are those of the zonal order. Some differences probably existed between the kinds of vegetation on the Planosols and on the Red-Yellow Podzolic soils, although deciduous forest was on both. From the standpoint of profile development the Planosols appear to be older than the Red-Yellow Podzolic soils, but the causes for development of older soils are not known. The relief is such that geological erosion would be slow, but that factor alone is not the cause of formation of the Planosols. The soil material itself is not older in years than that of associated zonal soils of similar relief. Relatively dense layers in the parent material and underlying rock strata may have caused slow internal drainage, which combined with slow external drainage and unusual siltiness of the parent material, resulted in abnormal concentration or cementation of the material in or below the illuvial horizon.

Roanoke Series

The Roanoke series is on level or slightly depressed stream terraces. The old alluvium from which it has formed was washed largely from uplands underlain by granite, but it includes a small admixture of a wide variety of materials. Both internal and external drainage are poor, owing to level relief, silty soil material, and impervious nature of the underlying rocks. The soil is medium to strongly acid.

Profile description:

A_1. 0 to 1 inch, medium-gray loose silt loam splotched with light gray.

A_2. 1 to 8 inches, light-gray friable silt loam with a weak medium crumb structure.

B_1. 8 to 14 inches, yellowish-gray moderately plastic heavy silty clay loam splotched with light gray and having a well-developed medium blocky structure.

B_2. (claypan). 14 to 28 inches, compact clay highly mottled with gray, yellow, rust brown, and black.

C. 28 to 48 inches, slightly compact clay highly mottled with gray and yellow; less compact and more permeable than the B_2 horizon.

Half Bog Group

Half Bog soils are an intrazonal group of soils with a mucky or peaty surface soil underlain by a gray mineral soil. They have

developed largely under swamp-forest types of vegetation, mostly in humid or subhumid climates (*15*). The principal soil-forming processes for these soils are organic-matter accumulation in the surface layer and gleization. These soils are formed where there is excess water throughout the profile much of the time. Aeration is poor. Organic matter does not decay so rapidly as it does on better drained soils, but accumulates in the surface layer. The lower part of Half Bog soils is subject to reducing conditions most of the time, and consequently the subsoil is bluish gray.

The Half Bog group is represented by the Burton series.

Burton Series

The Burton soil is developed from the residuum of granite and gneiss under a cover of mountain-oatgrass, rhododendron, or alder-birch thickets. The soil is at elevations of more than 5,200 feet on mountaintops, high mountain slopes, and in some of the high mountain gaps. Owing to the large quantity and frequency of rainfall, cool climate, low rate of evaporation, and in some places seepage, the soil is saturated much of the time. Aeration is poor, and the organic matter tends to accumulate in the surface layer. The classification of this soil is questionable, and in view of the above-mentioned factors it might be more properly classified as Alpine Meadow.

Profile description:

A_1. 0 to 14 inches, dark-gray (almost black) loose stony loam; consists mainly of organic matter in various stages of decay mixed with some mineral soil material.

A_3. 14 to 20 inches, yellowish-brown friable stony light clay loam stained grayish; moderate quantity of organic matter.

C. 20 to 36 inches, brownish-yellow to pale-yellow friable stony clay loam highly splotched with gray; granite bedrock at 3 feet.

AZONAL SOILS

Azonal soils are defined as a group of soils without well-developed soil characteristics because of their youth or because of conditions of parent material or relief that prevent the development of normal soil-profile characteristics (*15*).

Azonal soils have an A_1 horizon moderately dark to very dark and apparently moderately to fairly high in content of organic matter. They do not have a zone of illuviation, or B horizon, and their parent material is usually lighter in color than the A_1 horizon and may be similar to, lighter than, or heavier than the A_1 horizon in texture. They may be referred to as AC soils because the B horizon is absent.

The azonal soils are represented by Lithosols and Alluvial soils.

Lithosol Group

Lithosols are an azonal group of soils having no clearly expressed soil morphology and consisting of a recently and imperfectly weathered mass of rock fragments; they are largely confined to steeply sloping land (*15*). They occupy positions where geologic erosion is relatively rapid, and they generally consist of materials relatively easily eroded. As a result, material is removed from the surface or mixed to such extent that soil-forming processes have not had time enough to produce well-defined genetic soil properties. As mapped, these soils may include small areas of zonal soils.

The Ramsey, Dandridge, Teas, and Litz soils are classed as Lithosols. The three rough gullied land types mapped in the county are man-made Lithosols. The true soil has been lost from most of these areas because of accelerated erosion induced by man's activities.

Ramsey Series

Ramsey soils occupy hilly to very steep mountain slopes. They were formed from materials weathered from acid quartzite, sandstone, and conglomerate. Some acid shale or slate is in places. The underlying rocks weather slowly so that parent material is formed slowly. This material is removed by geological erosion almost as rapidly as it is formed; consequently, the soils are shallow and do not have well-developed profiles. The native vegetation was chiefly hardwood forest, although locally there is considerable pine in the present cover. These strongly acid soils are relatively infertile and support a very poor forest. As a result, they are low in organic matter.

Profile description:

A_1. 0 to 1 inch, medium-gray loose fine sandy loam stained with a moderate quantity of organic matter.

A_2. 1 to 9 inches, pale-brown or light yellowish-brown very friable stony fine sandy loam.

A_3. 9 to 14 inches, brownish-yellow friable stony fine sandy loam.

C. 14 to 36 inches, pale-yellow friable stony fine sandy loam with thin layers of soft partly disintegrated rock fragments.

D. 36 inches +, quartzite bedrock.

Dandridge Series

The soils of the Dandridge series have formed from the residuum of calcareous shale. They are predominantly hilly to very steep, and natural erosion apparently has been almost rapid enough to keep pace with soil development. Consequently, the soils are shallow, contain numerous shale fragments, and have very weakly developed profiles. The reaction is neutral to slightly acid.

Profile description:

A_1. 0 to 1 inch, brownish-gray very friable silt loam stained dark with organic matter.

A_2. 1 to 6 inches, yellowish-gray friable shaly silt loam.

C. 6 to 24 inches, brownish-yellow to yellowish-gray moderately plastic shaly silty clay loam containing a large quantity of soft partly disintegrated shale fragments; becomes lighter colored in the lower part and is mottled with yellow and gray.

D. 24 inches +, calcareous shale bedrock.

Teas Series

The Teas soils are derived from the residuum of purplish-red shale, typically calcareous, that is interbedded with thin lenses of limestone in most places. The soils have formed on characteristically rounded or domelike hills and have a predominantly hilly to very steep relief. Natural erosion apparently has been almost rapid enough to keep pace with soil development. The soils, therefore, are shallow, contain numerous shale fragments, and lack distinct profile development, although weakly developed profiles are included in the mapping units. These soils differ from the Dandridge chiefly in being more acid and in having a purplish color inherited from the parent rock. Reaction is slightly to strongly acid.

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Profile description:

A_1. 0 to 1 inch, dark purplish-gray loose shaly silt loam stained dark with organic matter.
A_2. 1 to 8 inches, purplish-gray friable shaly silt loam.
C. 8 to 24 inches, purplish-red moderately friable shaly silty clay loam to silty clay containing many partly disintegrated shale fragments; streaked and splotched with yellow, especially in the lower part.
D. 24 inches +, purplish-red shale bedrock.

Litz Series

The Litz soils of the rolling to very steep uplands have formed from residuum weathered from yellow acid shale that contains an occasional thin lens of limestone. Natural erosion has removed the soil material almost as fast as it has formed; consequently, the soils are shallow or very shallow, contain many shale fragments, and have very weakly developed profiles. They are lighter in color, more acid, and less fertile than either the Teas or Dandridge soils, apparently because of differences in parent material.

Profile description:

A_1. 0 to 1 inch, medium-gray loose shaly silt loam stained with organic matter.
A_2. 1 to 8 inches, grayish-yellow friable shaly silt loam.
C. 8 to 20 inches, brownish-yellow to yellow moderately friable shaly silty clay loam splotched with gray and yellow; very shaly and highly mottled in the lower part.
D. 20 inches +, bedrock of acid yellow shale with thin lenses of limestone.

Alluvial Group

Alluvial soils are an azonal group of soils developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the material by soil-forming processes (*15*). These soils are on first bottom lands along streams, in depressions, and on foot slopes. They have nearly level, gently sloping, and depressional relief and good to very slow internal drainage. Their main properties in common are those related to lack of a soil profile in which the horizons are genetically related. The properties of the soil are closely related to the alluvial deposit. Alluvial soils derived from similar parent material may differ in drainage, and some differences in properties exist because of drainage. In such instances the soils have been differentiated mainly on the basis of properties associated with good, imperfect, or poor drainage.

The Staser, Hamblen, Congaree, Chewacla, Wehadkee, Buncombe, Lindside, Ooltewah, Emory, Greendale, and Camp are Alluvial soils.

Staser and Hamblen Series

The Staser and Hamblen soils are derived from young general alluvium consisting of shale, quartzite, sandstone, and, in some places, limestone materials. These soils have formed on nearly level flood plains under a deciduous forest vegetation. The differences between soils of the two series are closely associated with differences in drainage. All are young and do not have developed profiles. In general, they are higher in bases, phosphorus, nitrogen, and organic matter than are the associated upland soils.

The well-drained Staser soil consists of grayish-brown loose fine sandy loam to a depth of about 14 inches. Below this the material

is yellowish-brown or brownish-yellow friable heavy loam or fine sandy loam. Gray splotching may occur below a depth of about 24 inches. The soil is slightly acid in most places.

The imperfectly drained Hamblen soil is a grayish-brown or brownish-gray very friable loam to depths of 14 to 18 inches, below which it is highly mottled and generally heavier in texture. This difference may be partly due to soil-forming processes, but it is more likely due to deposition.

Congaree, Chewacla, and Wehadkee Series

These young soils of the first bottoms have formed largely from alluvium washed from granite and gneiss. The material has not been in place long enough to develop genetically related horizons. Differences among the soils are closely associated with differences in drainage.

The well-drained Congaree soils are free of any mottlings to depths of 24 inches or more. The 14-inch surface layer is grayish-brown or brown very friable loam, and the material below, to about 30 inches, is brownish-yellow friable loam. In most places, this is underlain by light-colored stratified coarse- and fine-textured materials.

The imperfectly drained Chewacla soil consists of grayish-brown loose fine sandy loam to 12 to 18 inches. The material below this is highly mottled and variable in texture.

In most places the poorly drained Wehadkee soil is gray friable loam to about 18 inches, below which it is bluish-gray loam to loamy sand.

Buncombe Series

The Buncombe soil is on first bottoms and consists of recent alluvium washed largely from uplands underlain by granite and gneiss. The alluvium differs from that from which Congaree soils are formed chiefly in having a larger percentage of coarser separates, which are deposited by swift-flowing water, mainly on natural levees. The Buncombe soil is excessively drained and consists of loose brownish-yellow loamy fine sand throughout. The 3- or 4-inch surface layer is stained dark with organic matter in many places.

Lindside and Ooltewah Series

The Lindside and Ooltewah are young imperfectly drained soils that have not developed genetically related horizons. They are similar in source of parent materials, drainage, and significant profile characteristics, but they differ greatly in position, manner of occurrence, and associations. They consist of alluvium washed from uplands underlain by limestone or dolomitic limestone. The Lindside soil is on flood plains and is succeptible to flooding by adjacent streams. The Ooltewah soil is in depressions and is subject to ponding.

Both soils are grayish-brown or light-brown mellow very friable silt loams to depths of 12 to 18 inches. Below this, they are highly mottled silt loam to silty clay loam. The difference in texture may be partly due to soil-forming processes, but in most places, it is probably due to accidents of deposition.

Emory Series

The undulating to rolling Emory soils are on foot slopes and benches at the base of upland slopes, chiefly along intermittent streams. They were developed from local alluvium and colluvium washed largely from the associated Decatur and Dunmore soils. Both internal and external drainage are moderate. The soils were formed under hardwood forest and in a climate similar to that under which the associated zonal soils were developed, but their parent materials were so recently deposited that soil-forming processes have not had time to act and no genetic profile has developed.

Profile description:

1. 0 to 3 inches, dark grayish-brown very friable silt loam.
2. 3 to 20 inches, brown friable silt loam with a weak fine crumb structure.
3. 20 to 40 inches, reddish-brown to yellowish-brown moderately friable silt loam to silty clay loam.
4. 40 to 60 inches +, yellowish-brown moderately plastic silty clay loam.

Greendale Series

Greendale soils are on foot slopes, along intermittent drains, and on alluvial-colluvial fans. They have formed from materials washed from the adjacent slopes, chiefly from the Clarksville, Groseclose, and Fullerton soils. These materials are more siliceous, more strongly acid, and less fertile than those from which the Emory soils are formed. Most of the Greendale soils are so young and have such indistinct or weakly developed profiles that they are classed as Alluvial soils.

Profile description:

1. 0 to 2 inches, dark-gray mellow silt loam stained dark with organic matter.
2. 2 to 12 inches, grayish-brown to brownish-gray friable silt loam.
3. 12 to 30 inches, yellowish-brown to brownish-yellow friable silt loam or light silty clay loam.
4. 30 inches +, brownish-yellow friable silty clay loam or clay loam splotched with gray.

Camp Series

The Camp are purplish well-drained soils formed from recent local alluvium or colluvium washed chiefly from Teas soils. They have formed at the base of slopes from which their material was washed. This material has been in place long enough for the soil to develop genetically related horizons, but the profiles are indistinct or weakly developed. Reaction is medium acid.

Profile description:

1. 0 to 10 inches, purplish-gray friable silt loam.
2. 10 to 20 inches, light purplish-brown shaly heavy silt loam or silty clay loam.
3. 20 to 48 inches, purplish-brown or purplish-red friable silty clay loam.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field. The soil scientist walks over the area at intervals not more than one-quarter mile apart and bores into the soil with an auger or digs holes with a spade. Each such boring or hole shows the soil to consist of several distinctly different layers, called horizons, which collectively are known as the soil profile. Each of these layers is studied carefully for the things about it that affect plant growth.

The color of each layer is noted. The darkness of the topmost layer is usually related to its content of organic matter. Streaks and spots of gray, yellow, and brown in lower layers generally indicate poor drainage and poor aeration. Texture, or the content of sand, silt, and clay in each layer, is determined by the way the soil feels when rubbed between the fingers and is checked by mechanical analyses in the laboratory. Texture has much to do with the quantity of moisture the soil will hold available to plants, whether plant nutrients or fertilizers will be held by the soil in forms available to plants or will be leached out, and how hard the soil may be to cultivate. Structure, or the way the soil granulates, and the quantity of pore or open space between particles indicate how easily plant roots can penetrate the soil and how easily water enters it. Consistence, or the tendency of the soil to crumble or to stick together, indicates how difficult it is to keep the soil open and porous under cultivation.

The kinds of rocks and the parent material from which the soil has been developed affect the quantity and kind of plant nutrients the soil may have. Simple chemical tests show how acid the soil may be. The depth to bedrock or to compact layers is determined. The quantity of gravel or rocks that may interfere with cultivation, the steepness and kind of slope, the quantity of soil lost by erosion, and other external features are observed.

On the basis of all these characteristics, soil areas much alike in the kind, thickness, and arrangement of layers are mapped as one soil type. Some soil types are separated into two or more phases. For example, if a soil type has slopes that range from 2 up to 15 percent, it may be mapped in two phases, an undulating phase (2- to 7-percent slopes) and a rolling phase (7- to 15-percent slopes). A soil that has been eroded in places may be mapped in two or more phases, an uneroded, or normal, phase (denoted by the name of the soil type only), an eroded phase, and perhaps a severely eroded phase. A soil type will be broken into phases primarily because of differences in the soil other than those of kind, thickness, and arrangement of layers. The slope of a soil, the frequency of outcropping bedrock, the extent of erosion, and artificial drainage are examples of characteristics that might cause a soil type to be divided into phases.

Two or more soil types may have similar profiles; that is, the soil layers may be nearly the same, except that the texture, especially of the surface layer, will differ. As long as the other characteristics of the soil layers are similar, these soils are considered to belong in the same soil series. A soil series therefore consists of one or more soil

types that are, except for texture, particularly texture of the surface layer, about the same in kind, thickness, and arrangement of layers.

The name of a place near where a soil series was first found is chosen as the name of the series. Congaree is the name of a well-drained soil series found on water-laid deposits in Carter County, Tenn. Two types of the Congaree series are mapped in the county—Congaree loam and Congaree fine sandy loam. These differ in the texture of the surface soil, as their names show.

When very small areas of two or more kinds of soil are so intricately mixed that they cannot be shown separately on a map of the scale used, they are mapped together, and the areas of the mixture are called a soil complex. Teas-Litz silt loams, hilly phases, is a complex of Teas silt loam, hilly phase, and Litz silt loam, hilly phase, in Carter County.

Areas such as bare rocky mountainsides and very stony or badly gullied areas that have little true soil are not designated with series and type names but are given descriptive names, such as Stony hilly land (Dunmore soil material), Rough gullied land (Dandridge soil material), and Quartzite and granite rockland.

The soil type, or where the soil type is subdivided, the soil phase, is the unit of mapping in soil surveys. It is the unit or the kind of soil that is most nearly uniform and has the narrowest range of characteristics. For this reason land use and soil management practices can be more definitely specified for it than for broader groups of soils that contain more variation. One can say, for example, that soils of the Hiwassee series need lime for alfalfa. More specifically it can be said that Hiwassee clay loam, eroded undulating phase, has mild slopes and, in addition to needing lime, is suited to row crops in a rotation with small grain and hay; whereas Hiwassee clay loam, eroded hilly phase, has slopes that fall more than 15 feet in 100, is hard to work with heavy machinery, erodes easily, and should be used principally for long-term hay or pasture and tilled on the contour. Both phases are in the Hiwassee series.

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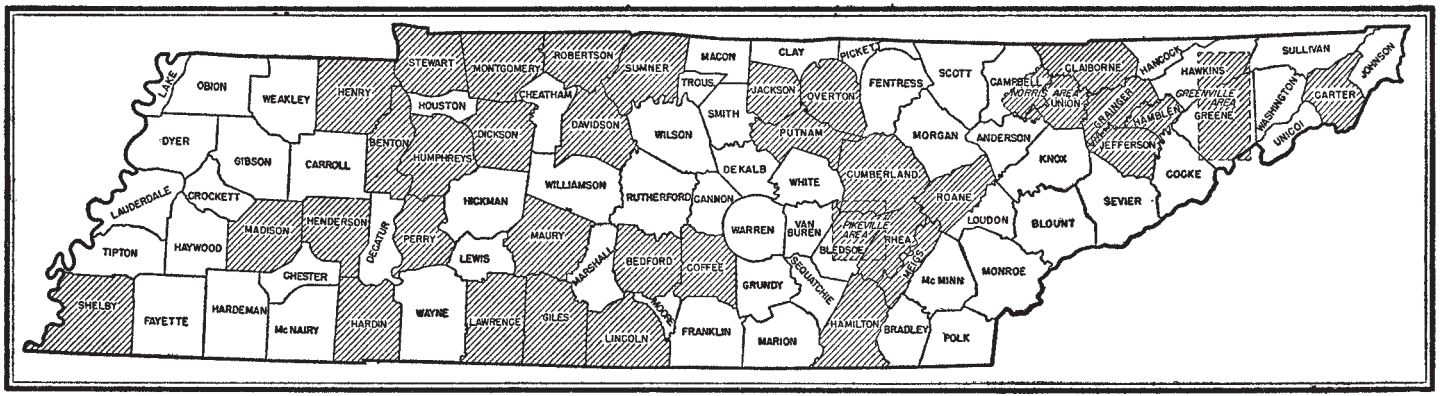

Areas surveyed in Tennessee shown by shading.

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