SOIL SURVEY

Knox County Tennessee

Series 1942, No. 10

Issued August 1955

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 know about the soil differences on their farms, perhaps also about differences on the farms 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 on other farms, either in their State or other States, where farmers have gained experience with new or different farming practices or farm enterprises. They do not know whether higher yields obtained by farmers in other parts of their county and State are from soils like theirs or from soils so different that they could not hope to get yields as high, even if they followed the same practices. One way for farmers to avoid some of the risk and uncertainty involved in trying new production methods and new varieties of plants is to learn what kinds of soils they have, so that they can compare them with the soils on which new developments have proved successful.

SOILS OF A PARTICULAR FARM

To find what soils are on any farm or other area, it is necessary first to locate this area on the map that accompanies this report. This is easily done by using landmarks such as roads, streams, villages, dwellings, and other features to locate the boundaries.

Each kind of soil mapped within the farm or tract is marked on the map with a symbol. For example, all the areas marked Ec are Emory silt loam, undulating phase. The color in which the soil area is shown on the map will be the same as the color indicated on the legend for this particular type of soil. If you want information on the Emory soil, turn to the section in this publication on Soil Types and Phases and find Emory silt loam, undulating phase. Under this heading you will find a statement of what the characteristics of this soil are, what it is mainly used for, and some of the uses to which it is suited.

Suppose, for instance, you wish to know how productive Emory silt loam, undulating phase, is? You will find it listed in the left-hand column of table 4. Opposite the name you can read the yields for different crops grown on the soil. This table also gives estimated yields for all the other soils mapped in the county.

If, in addition, you wish to know what good use and management practices are recommended for Emory silt loam, undulating phase, read what is said about this in the section on Soil Types and Phases. Refer also to the section headed Use and Management Requirements of Groups of Soils, where soils suited to the same use and management practices are grouped together.

SOILS OF THE COUNTY AS A WHOLE

A general idea of the soils of the county is given in the section on General Nature of the Soils, which tells about the principal kinds of soils, where they are found, and how they are related to one another. After reading this section, 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 to the county, especially if he considers purchasing a farm, will want to know about the climate; the types and sizes of farms; the principal farm products and how they are marketed; the kinds and conditions of farm tenure; availability of roads, railroads, and electric services; water supplies; industries of the county; and cities, villages, and population characteristics. Information about all these will be found in the sections on General Nature of the Area and Additional Facts about Knox 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 Knox County, Tenn., is a cooperative contribution from the—

SOIL CONSERVATION SERVICE

the

TENNESSEE AGRICULTURAL EXPERIMENT STATION

and the

TENNESSEE VALLEY AUTHORITY

Series 1942, No. 10 Issued August 1955

SOIL SURVEY OF KNOX 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

CONTENTS

	Page
General nature of the area	4
Location and extent	4
Organization and population	4
Physiography, relief, and drainage	5
Climate	7
Vegetation	8
Water supply	9
Wildlife	9
Land use and types and sizes of farms	10
Soil survey methods and definitions	11
The soils of Knox County, their use and management	12
General nature of the soils	12
Soil types and phases	23
Alcoa silt loam:	
Eroded undulating phase	27
Eroded rolling phase	28
Armuchee silty clay loam, eroded hilly phase	28
Armuchee silt loam, steep phase	29
Armuchee silty clay loam, eroded steep phase	30
Bland silt loam, rolling phase	31
Bland silty clay loam:	
Eroded rolling phase	32
Eroded hilly phase	32
Bland silt loam, steep phase	33
Bland silty clay loam, eroded steep phase	34
Bolton silt loam, eroded hilly phase	34
Bolton silty clay loam, severely eroded hilly	35
Bolton silt loam, eroded steep phase	36
Bolton silty clay loam, severely eroded steep phase	37
Bolton silt loam, eroded rolling phase	37
Bolton silty clay loam, severely eroded rolling phase	38
Camp silt loam	39
The soils of Knox County—Con.	
Soil types and phases—Con.	
Chewacla silt loam	40
Clarksville cherty silt loam:	
Rolling phase	41
Eroded rolling phase	42
Hilly phase	42
Eroded hilly phase	43
Steep phase	44
Eroded steep phase	44
Colbert silty clay loam:	
Eroded undulating phase	45
Eroded rolling phase	46
Colbert silty clay:	
Severely eroded rolling phase	47
Severely eroded hilly phase	48
Congaree fine sandy loam	48
Low-bottom phase	49
Congaree silt loam	50
Low-bottom phase	51
Cumberland silty clay loam:	
Eroded undulating phase	51
Eroded rolling phase	53
Severely eroded rolling phase	54
Eroded hilly phase	54
Severely eroded hilly phase	55
Cumberland gravelly fine sandy loam, eroded rolling phase	56
Dandridge shaly silt loam, eroded hilly phase	57
Dandridge silt loam, steep phase	58
Dandridge shaly silt loam, eroded steep phase	58
Dandridge and Litz silt loams, hilly phases	59
Dandridge and Litz shaly silt loams, eroded hilly phases	60
Dandridge and Litz silt loams, steep phases	61
Dandridge and Litz shaly silt loams, eroded steep phases	62

[1] Field work for this survey was directed by the Division of Soil Survey while it was a part of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration. The Division was transferred to the Soil Conservation Service on November 15, 1952.

Page

The soils of Knox County—Con.
Soil types and phases—Con.
Decatur silt loam, undulating phase 62
Decatur silty clay loam, eroded undulating phase 63
Decatur silt loam, rolling phase 64
Decatur silty clay loam:
Eroded rolling phase 65
Severely eroded rolling phase 66
Eroded hilly phase 67
Severely eroded hilly phase 68
Dewey silt loam, undulating phase 68
Dewey silty clay loam, eroded undulating phase 69
Dewey silt loam, rolling phase 70
Dewey silty clay loam:
Eroded rolling phase 71
Severely eroded rolling phase 72
Eroded hilly phase 73
Severely eroded hilly phase 73
Eroded steep phase 74
Emory silt loam:
Undulating phase 75
Rolling phase 76
Emory and Abernathy silt loams 77
Etowah silt loam, undulating phase 78
Etowah silty clay loam:
Eroded undulating phase 79
Eroded rolling phase 80
Eroded hilly phase 81
Severely eroded hilly phase 82
Farragut silty clay loam:
Eroded undulating phase 82
Eroded rolling phase 83
Eroded hilly phase 84
Fullerton silt loam:
Undulating phase 85
Eroded undulating phase 86
Rolling phase 86
Eroded rolling phase 87
Fullerton silty clay loam, severely eroded rolling phase 88
Fullerton silt loam:
Hilly phase 88
Eroded hilly phase 89
Fullerton silty clay loam, severely eroded hilly phase 90
Fullerton cherty silt loam:
Rolling phase 90
Eroded rolling phase 91

Page

The soils of Knox County—Con.
Soil types and phases—Con.
Fullerton cherty silty clay loam, severely eroded rolling phase 92
Fullerton cherty silt loam:
Hilly phase 93
Eroded hilly phase 93
Fullerton cherty silty clay loam, severely eroded hilly phase 94
Fullerton cherty silt loam:
Steep phase 94
Eroded steep phase 95
Fullerton cherty silty clay loam, severely eroded steep phase 95
Fullerton loam:
Undulating phase 96
Eroded undulating phase 97
Rolling phase 97
Eroded rolling phase 98
Hilly phase 99
Eroded hilly phase 99
Greendale silt loam:
Undulating phase 100
Rolling phase 100
Greendale cherty silt loam:
Undulating phase 102
Rolling phase 103
Gullied land:
Armuchee and Litz soil materials 103
Fullerton and Talbott soil materials 104
Sequoia and Montevallo soil materials 104
Talbott and Decatur soil materials 105
Tellico and Muskingum soil materials 106
Guthrie silt loam 106
Hamblen fine sandy loam 107
Hamblen silt loam 109
Huntington silt loam 110
Low-bottom phase 111
Jefferson loam, eroded rolling phase 111
Jefferson and Montevallo loams:
Eroded undulating phases 112
Eroded rolling phases 113
Jefferson and Montevallo clay loams, severely eroded rolling phases 114
Leadvale and Cotaco loams:
Undulating phases 114
Rolling phases 116
Leadvale and Whitesburg silt loams:
Undulating phases 116
Rolling phases 117
Limestone rockland:
Rolling and hilly 118
Steep 118

Page

The soils of Knox County—Con.
Soil types and phases—Con.
Lindside silt loam 118
Made land 119
Melvin silt loam 119
Montevallo silt loam, steep phase 120
Montevallo shaly silt loam:
Eroded steep phase 121
Eroded hilly phase 121
Eroded rolling phase 122
Eroded undulating phase 122
Muskingum stony fine sandy loam, steep phase 123
Muskingum-Lehew fine sandy loams:
Steep phases 124
Eroded steep phases 124
Hilly phases 125
Eroded hilly phases 126
Neubert loam:
Undulating phase 126
Rolling phase 127
Nolichucky gravelly loam, eroded rolling phase 127
Ooltewah silt loam 128
Prader silt loam 129
Roane silt loam 130
Sequatchie fine sandy loam 131
Sequoia silt loam, undulating phase 132
Sequoia silty clay loam:
Eroded undulating phase 133
Severely eroded undulating phase 134
Sequoia silt loam, rolling phase 135
Sequoia silty clay loam:
Eroded rolling phase 136
Severely eroded rolling phase 137
Sequoia-Bland silty clay loams:
Eroded undulating phases 137
Eroded rolling phases 139
Severely eroded rolling phases 139
Eroded hilly phases 140
Severely eroded hilly phases 140
Staser silt loam 141
Staser fine sandy loam 142
Low-bottom phase 143
Stony rolling land, Colbert and Talbott soil materials 143
Stony hilly and steep land, Colbert and Talbott soil materials 144
Stony very steep land, Muskingum soil material 144
Talbott silty clay loam:
Eroded undulating phase 145
Eroded rolling phase 146

Page

The soils of Knox County—Con.
Soil types and phases—Con.
Talbott silty clay loam—Con.
Severely eroded rolling phase 147
Severely eroded hilly phase 147
Tellico loam:
Hilly phase 148
Eroded hilly phase 149
Tellico clay loam, severely eroded hilly phase 149
Tellico loam:
Steep phase 150
Eroded steep phase 151
Tellico clay loam, severely eroded steep phase 151
Tellico loam:
Rolling phase 152
Eroded rolling phase 153
Tellico clay loam, severely eroded rolling phase 154
Tyler silt loam 154
Waynesboro loam:
Eroded undulating phase 155
Eroded rolling phase 156
Eroded hilly phase 157
Waynesboro clay loam, severely eroded hilly phase 158
Wolftever silty clay loam:
Eroded undulating phase 158
Eroded rolling phase 159
Use and management requirements of groups of soils 160
Expectable average yields 183
Other soil groupings 192
Use suitability groups 193
First-class soils 193
Second-class soils 194
Third-class soils 194
Fourth-class soils 194
Fifth-class soils 195
Soil associations 195
Jefferson-Bolton-Clarksville soil association 196
Stony land-Talbott soil association 197
Muskingum-Lehew soil association 197
Jefferson-Montevallo soil association 198
Cumberland-Huntington soil association 198
Decatur-Dewey-Emory soil association 199
Sequoia-Litz-Dandridge soil association 199
Dandridge-Litz-Leadvale soil association 200
Tellico-Neubert soil association 201
Armuchee-Leadvale soil association 201

	Page
Other soil grouping—Continued	
Soil associations—Continued	
Staser-Hamblen soil association	201
Bland-Camp soil association	202
Sequoia-Leadvale soil association	202
Sequoia-Bland soil association	203
Montevallo soil association	203
Additional facts about Knox County	204
Industries	204
Transportation and markets	204
Community, farm, and home facilities	205
Crops	205
Rotations and fertilizers	207
Permanent pastures	208
Livestock and livestock products	209
Farm power and mechanical equipment	210
Additional facts about Knox County—Continued	
Farm tenure	210
Forests	210
Forest resources	211
Forest types	211
Forest management	212
Morphology and genesis of soils	215
Factors of soil formation as related to Knox County soils	216
Classification of soils	219
Morphology of soils representing the great soil groups	223
Red-Yellow Podzolic soils	223
Red members	223
Yellow members	230
Planosols	232
Alluvial soils	234
Lithosols	238
Literature cited	240

KNOX COUNTY, in the Valley of East Tennessee, is on predominantly rolling and hilly relief but has some steep and rugged areas. Corn and hay are the most important crops. General farming, based on dairying and supplemented by a cash crop of tobacco, is common in the more productive sections. Truck farming is also prevalent. Knoxville, centrally located in the county, is an important industrial and trading center and provides part-time employment for many rural inhabitants and also markets for farm produce. To provide a basis for the best agricultural uses for 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 for this survey was completed in 1942. Unless otherwise specifically mentioned, statements in this report refer to conditions in the county at the time field work was completed.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Knox County is in the central part of East Tennessee (fig. 1). The total area of the county is approximately 329,600 acres, or 515 square miles.

ORGANIZATION AND POPULATION

Knox County was organized in 1792. Blount County was established from a part of Knox County in 1795; a small part of Grainger County was added to Knox in 1927, and a small part of Sevier County in 1933. At the time Knox County was established, the few white inhabitants lived chiefly in forts along Beaver Creek. Most of the early white settlers were from Virginia, North Carolina, and the northeast-

ern part of Tennessee. Many soldiers of the Revolutionary War took up claims in payment for their services. The first home in the area now occupied by Knoxville was built in 1786 (*6*).[2]

In 1950 there were 148,166 urban and 74,841 rural people in Knox County. Knoxville is the only incorporated urban area. With its adjoining communities, it includes practically all the urban population of the county. Mascot is the largest village not included in this urban area. Most of the present inhabitants of the county are of English, Scotch, and Irish descent.

Rural population is fairly well distributed over the county. The most sparsely populated rural sections are House Mountain, McAnnally Ridge, Chestnut Ridge, and Copper Ridge. The most densely populated are near Knoxville. More than half of the rural inhabitants do not depend entirely upon farming for a living. Many are employed in Knoxville and nearby industrial plants; some are employed in lumbering and marble quarrying, and a few by the county on public works.

FIGURE 1.—Location of Knox County in Tennessee.

PHYSIOGRAPHY,[3] RELIEF, AND DRAINAGE

Knox County lies wholly within the Ridge and Valley, or Great Valley, physiographic province (*5*) of the southeastern United States. Locally this southern extremity of the province is known as the Valley of East Tennessee. The rock exposures are of the Cambrian, Ordovician, and Silurian geologic systems and are chiefly dolomitic limestones, limestones, and shales. The rock formations have been severely folded and faulted. Differential weathering and subsequent geologic erosion have caused ridges to form on the more resistant rocks, and valleys on the less resistant ones. As a consequence the dominant ridges and valleys follow the strike of the rock formations exposed. The result is a system of parallel ridges and valleys, the axes of which extend in a northeast-southwest direction. Most of the more rugged ridges are on interbedded sandstone and shale and calcareous sandstone; the more extensive valleys are on soft shale and argillaceous limestone. Much of the landscape over cherty dolomitic limestone is very nearly as high as the rugged shale ridges but the areas are broader and less sharply broken.

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[2] Italic numbers in parentheses refer to Literature cited, p. 240.

[3] For a more detailed description of the physiography of the county and its relation to the soils, see the section on Soil Associations.

The lay of the land is prevailingly rolling and hilly, but some areas on the ridges underlain by the more resistant rock are steep and rather rugged. Elevations above sea level range from 740 feet, at the surface of Clinch River where it leaves the county, to 2,128 feet, at the highest point on House Mountain. The difference in elevation between the valleys and ridges ranges approximately from 180 to 400 feet, except for House Mountain, which rises approximately 900 feet above the adjacent upland. Approximate elevations in feet above sea level of points that represent the general relief are: French Broad River, where it enters the county, 842; Fort Loudoun Reservoir, 813; the crest of Bays Mountains, a rugged ridge along the Knox-Sevier County line, 1,350 to 1,500; Tarklin Valley, to the northwest of Bays Mountains, 960 to 1,100; the crest of Blackoak Ridge, a ridge underlain by dolomitic limestone, 1,260 to 1,360; Hinds Valley, a valley over shale northwest of and adjacent to Blackoak Ridge, 1,020 to 1,160; and Beaver Ridge, adjacent to and northwest of Hinds Valley, 1,300 to 1,400.

The total area of alluvium is not great, considering the size of the streams that flow through the county. The larger alluvial plains are along the Tennessee, French Broad, Holston, and Clinch Rivers. The first bottoms, or flood plains, lie as narrow strips along the channels. Most of the bottoms are 300 to 800 feet wide; a few are about one-half mile wide. The stream terraces or benches are 15 feet to about 140 feet above the adjacent first bottoms. These terraces lie in irregular, discontinuous areas in the vicinity of the large streams. Few are as much as one-half mile wide.

The older, higher lying areas of terraces represent remnants of very old alluvial plains. Subsequent erosion has developed a rolling to hilly surface, and the alluvium ranges from scattered cobblestones on sedentary material to a layer 20 or 30 feet thick. The alluvium along the French Broad and Tennessee Rivers is a mixture of materials originating from shales, limestones, sandstones, and metamorphosed micaceous rocks. Along the other streams it is the same except for the lack of materials from micaceous rocks.

The drainage system is well developed. The larger streams flowing in the valleys form the main stems of a trellis system. In many places, streams flow through gaps in the ridges. In those parts of the county overlying dolomitic limestone, a karstlike topography prevails. Here a great many of the small drains lead to sinkholes, where the runoff water enters subterranean channels. Part of the runoff water, however, proceeds through a partially formed dendritic surface system to permanent surface streams in the shale valleys. Poorly drained areas are confined to small tracts along some of the drainageways and first bottoms and on floors of some of the sinkholes.

The French Broad and Holston Rivers, draining the eastern part of the county, converge about 4 miles east of Knoxville to form the Tennessee River. The northwest third of the county drains to the Clinch River, which joins the Tennessee River in the vicinity of Kingston in Roane County.

CLIMATE

The climate of Knox County is of the modified continental type. According to the classification of weather by Koppen (*15*), it has a warm and temperate climate with no distinct dry season but with hot summers in which the temperature of the warmest month averages 76.7° F. Long hot or cold periods are not common. Seasonal changes are usually gradual. The nearby mountains apparently have a moderating effect on weather in the Valley of East Tennessee. The United States Weather Bureau summary states: "The high mountains on the southeast act as a barrier to divert the hot southerly winds which occur when the presure is high off the South Atlantic Coast, with the result that the maximum temperatures experienced in this valley are lower than those beyond the mountains in any direction. On the other hand, the Cumberland Plateau on the northwest retards and weakens the force of cold waves." The mountains also break the force of winds, as tornadoes are almost unknown in the valley and average wind velocity is low.

The generally mild and open winters allow outdoor farm work throughout the year. Many plants retain their green leaves through the winter. Native flowers bloom during most months of the year. Winter vegetables, winter grains, and perennials rarely suffer damage from cold. The average date of the last killing frost in spring is April 1, and that of the first in fall is October 28. The ground is seldom frozen to a depth of more than 2 inches and rarely remains frozen for more than a few hours. The alternate freezing and thawing tends to loosen the surface soil, however, and to render it especially susceptible to erosion. Winter crops are sometimes damaged by heaving. Moderate climatic conditions favor the raising of livestock and poultry, but fruits are often killed by freezes that follow warm spells in early spring.

The hills and the narrow intervening valleys of the county are favorable for nocturnal radiation. Almost without exception, cool and comfortable nights follow high temperatures during the day. The weather is seldom too severe for the enjoyment of outdoor recreation such as golf, hiking, and fishing.

The more important climatic data for the county, compiled from the records of the United States Weather Bureau Station at Knoxville, are given in table 1.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Knoxville, Knox County, Tenn.*

[Elevation, 974 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Total for the driest year	Total for the wettest year	Average snowfall
	° F.	*° F.*	*° F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	39. 1	75	−5	4. 52	2. 30	7. 21	2. 1
January	38. 6	74	−16	4. 66	2. 19	6. 92	2. 7
February	40. 8	79	−10	4. 51	3. 78	10. 18	2. 4
Winter	39. 5	79	−16	13. 69	8. 27	24. 31	7. 2
March	47. 5	88	5	5. 05	4. 41	13. 07	1. 4
April	57. 3	93	23	4. 14	1. 39	5. 86	. 2
May	66. 7	95	34	3. 75	4. 21	1. 23	(3)
Spring	57. 2	95	5	12. 94	10. 01	20. 16	1. 6
June	73. 8	99	42	4. 10	2. 60	4. 96	0
July	76. 7	104	52	4. 36	1. 86	7. 64	0
August	75. 4	101	50	3. 92	2. 03	5. 60	0
Summer	75. 3	104	42	12. 38	6. 49	18. 20	0
September	69. 4	102	35	2. 68	4. 56	4. 14	0
October	58. 5	94	24	2. 62	1. 44	2. 81	(3)
November	46. 5	80	8	3. 07	2. 90	4. 25	. 3
Fall	58. 1	102	8	8. 37	8. 90	11. 20	. 3
Year	57. 5	104	−16	47. 38	[4] 33. 67	[5] 73. 87	9. 1

[1] Average temperature based on 78-year record, 1870 to 1947; highest and lowest temperatures from 61-year record, 1870 to 1930.
[2] Average precipitation based on 79-year record, 1870 to 1948; wettest and driest years based on 81-year record, 1870 to 1950; snowfall on 48-year record, 1883 to 1930.
[3] Trace.
[4] In 1930.
[5] In 1875.

VEGETATION

According to the classification of natural vegetation by Shantz and Zon (*11*), this county is in the chestnut-chestnut oak-yellow poplar belt of the Eastern forest region. The original vegetation was predominantly hardwoods and mixed hardwoods and pines. Chestnut, chestnut oak, white, red, and post oaks, hickory, ash, elm, maple, gum, beech, holly, white poplar, yellow-poplar, and yellow pine were the dominant species. Approximately 92,500 acres are now forested (*12*). Second-growth oak, hickory, dogwood, and shortleaf pine predominate in the present forest cover. Smaller proportions of yellow-poplar, beech, maple, and elm are intermixed in places. Little walnut

remains, and all the chestnut trees were killed by a blight before about 1930.

Most of the cleared land in farms is used for crops and pasture, although there is a notable acreage idle. On idle land and poorly managed pastures, the vegetation consists largely of wild grasses, broomsedge and other weeds, blackberry, persimmon, and sassafras. Volunteer stands of shortleaf pine are well established on many abandoned areas. A few areas have been planted to shortleaf and loblolly pine, and some to black locust and black walnut.

WATER SUPPLY

This county has a varied and, in most sections, abundant supply of water for livestock and household use. The rivers that drain the county supply some farms with stock water. Several large creeks and their permanent tributaries supply running water to a relatively large number of farms. Most of the creeks are moderately swift and clear except during flood periods. During the winter, spring, and early summer, enough water is available in practically all parts of the county. Late in summer and early in fall many small streams are dry and in some areas shallow wells are not reliable.

In the valleys of the cherty ridges of the Fullerton-Bolton-Clarksville soil association, larger streams generally flow continously; but permanent springs are not numerous, and many dug and bored wells commonly fail in exceptionally dry periods. Consequently, many farms in this section depend either partially or entirely on cisterns and artificial ponds for water. Permanent springs and streams, natural ponds, and reliable bored wells are common in the limestone valleys (Decatur-Dewey-Emory and Stony land-Talbott soil associations). Dug and bored wells in the shale valleys (Jefferson-Montevallo, Sequoia-Leadvale, and Sequoia-Litz-Dandridge soil associations) are widely used and dependable. A few springs and permanent streams are in these areas also. An abundant supply of water is available from streams, wells, and springs on the first bottoms along the rivers and creeks. Water is commonly available either from the streams or wells in the valley parts of the Dandridge-Litz-Leadvale and Tellico-Neubert soil associations.

Fort Loudoun Lake is the reservoir for the water impounded by Fort Loudoun Dam, on the Tennessee River about 30 miles downstream from Knoxville. The dam is one of a series built by the Tennessee Valley Authority on the Tennessee River and its tributaries for flood control, navigation, and the generation of electricity. The lake covers about 13 square miles, with a total shoreline of about 343 miles. It extends about 35 miles upstream to the confluence of the Holston and the French Broad Rivers. There are a few other small ponds or lakes in the county. Some are natural lakes in sinkholes and a few were formed by damming small streams.

Fort Loudoun Reservoir and some of the smaller bodies of water provide facilities for boating, fishing, and swimming.

WILDLIFE

Game animals and birds are limited in numbers. Squirrel, wild dove, and quail are probably the most common. Several lakes pro-

vide for fishing. According to data from the Tennessee Valley Authority, fishing increased 10- to 15-fold within a few years following the impoundment of water in lakes on the Tennessee River and its tributaries. Pike, bass, white bass, and jack salmon are the principal game fish. Bream, catfish, drum, and other species are common and of good food quality.

LAND USE AND TYPES AND SIZES OF FARMS

The total land in farms in Knox County decreased from 253,828 acres in 1930 to 217,750 in 1950. The number of farms increased from 4,039 in 1930 to 4,294 in 1950. Consequently, the average size of farms decreased in the same period. This increase in number and decrease in size of farms reflects the greater population in 1950 and the consequent pressure on the land.

In 1950, land in farms according to use was classified as follows: Cropland harvested, 66,954 acres; cropland used only for pasture, 39,477; other land pastured (not cropland and not woodland), 31,395; woodland, 49,679; cropland not harvested and not pastured, 14,807; and other land (house lots, roads, wasteland, etc.), 15,438. As reported in 1950, cropland used only for pasture included rotation pasture. Other land pastured was rough land and brushland or land that did not classify either as cropland or woodland. A large part of the woodland, 15,983 acres, was pastured. There are no large publicly owned areas, but about 38 percent of the forest is on private nonfarm land.

General farming, in which dairying is a chief enterprise (pl. 1) and tobacco an important cash crop, is common in the more productive sections. Truck farming, prevalent but less so than dairying, is practiced chiefly on soils that are easily conserved and at least moderately productive. Farms producing mainly for household use are found in some of the more remote and less fertile sections.

The farms of the county were classified in 1950 as follows: Miscellaneous and unclassified, 3,148; dairy, 288; livestock other than dairy and poultry, 283; field-crop other than vegetable and fruit-and-nut, 274 (of which, 255 were other field-crop, and 19 were cash-grain); general, 186 (of which, 142 were crop and livestock, 34 were primarily crop, and 10 were primarily livestock); poultry, 61; and vegetable, 54.

In 1950, 66.6 percent of the county was land in farms, and 55.7 percent of the land in farms was cropland. On the average, the farms were 50.7 acres in size, 28.2 acres of which was cropland.

Of the total number of farms reported, 901 were of less than 10 acres; 2,038 were from 10 to 49 acres; 787 from 50 to 99 acres; 395 from 100 to 179 acres; 102 from 180 to 259 acres; 63 from 260 to 999 acres; and 8 of 1,000 or more acres.

Most of the larger farms are along the rivers, in the valleys west of Ten Mile Creek, in Beaver Valley, and in Hardin Valley. These are the more productive parts of the county and the most suitable for the use of heavy farm machinery. The smaller farms are chiefly on the cherty ridges, in the valleys underlain by shales, and near the city of Knoxville.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of examining, classifying, 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. There is usually a relationship between the darkness of the topmost layer of soil and its content of organic matter; streaks and spots of gray, yellow, and brown in lower layers generally indicate poor drainage and poor aeration.

Texture—the content of sand, silt, and clay in each layer—is determined by the feel of the soil when rubbed between the fingers and is checked by mechanical analyses in the laboratory. Texture determines to a considerable degree the quantity of moisture the soil will hold available to plants, and the amount and nature of the clay determine to a great degree the tilth of the soil and how well plant nutrients are held available to plants.

Soil structure, or granulation, and the number and size distribution of pores or open spaces between soil particles determine to great extent the soil's capacity for holding moisture available for plants and the ease with which plant roots, air, and water penetrate the soil.

Consistence, or the tendency of the soil to crumble or to stick together, determines the degree of difficulty that will be encountered in keeping the soil open and porous under cultivation. Consistence covers such soil characteristics as hardness, friability, plasticity, stickiness, compactnes, toughness, and cementation.

Surface soil ordinarily refers to the surface layer, which is usually 5 to 10 inches thick. The layer just below the surface soil is the subsoil; the layer beneath the subsoil, the substratum.

The kinds of rocks and the parent soil material that develops from these rocks affect the quantities and kinds of plant nutrients found in the soil. Simple chemical tests are made to show the degree of acidity of the soil, and the depth to bedrock or to compact layers is measured. 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 the characteristics here listed, 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 ranging from 2 to 25 percent, the type may be mapped in three phases: An undulating phase (2 to 5 percent slopes), a rolling phase (5 to 12 percent slopes), and a hilly phase (12 to 25 percent slopes).

A soil that has been eroded in places may be mapped in two or more phases—an uneroded phase, an eroded phase, and perhaps a severely eroded phase. A soil type is 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, or artificial drainage, for example, are characteristics that might cause a surveyor to divide a soil type 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, may 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 all soil types, whether the number be only one or several, that are, except for texture—particularly the 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; thus, Colbert is the name of a soil series found in Colbert County, Alabama. Two types of the Colbert series are found in Knox County, Tenn.—Colbert silty clay loam and Colbert silty clay. Each of these soil types has a distinct surface soil texture, as its name indicates.

When very small areas of two or more kinds of soil are so intricately mixed 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. Muskingum-Lehew fine sandy loams is a complex of Muskingum fine sandy loam and Lehew fine sandy loam in Knox County.

Gullied land, limestone rockland, and stony land that have little agricultural value or little true soil are known as miscellaneous land types and are not designated with series and type names but are given descriptive names, as Gullied land (Armuchee and Litz soil materials) Limestone rockland (rolling and hilly) and Stony very steep land (Muskingum soil material).

The soil type or, where the soil type is subdivided, the soil phase, is the mapping unit 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 include more variation.

THE SOILS OF KNOX COUNTY, THEIR USE AND MANAGEMENT

GENERAL NATURE OF THE SOILS

Soils on uplands occupy about 76 percent of the county; those on alluvial foot slopes and along drains, 14 percent; those on stream terraces, 3 percent; and those on first bottoms, 7 percent.

The upland soils have formed over high-grade limestone, cherty limestone, clayey or argillaceous limestone, calcareous shale, interbedded shale and limestone, calcareous sandstone, acid shale, or interbedded shale and sandstone. Soils on uplands have greater range in characteristics and in use suitability and management requirements than those of the other groups. Most of the steep and all of the shallow soils are of this group, as well as some of the smoothest and most fertile soils.

Soils from alluvium on foot slopes and along small drains are widely distributed throughout the upland. There are only a few

areas of more than 50 acres, except along the foot of the steep shaly ridges. In great part, the soils of this group are suited to crops; practically all of them not suited to crops are suited to pasture. These soils require more exacting management than those on first bottoms, as they are lower in fertility, more susceptible to erosion, and more difficult to work and maintain.

The soils on stream terraces and those on first bottoms are chiefly along the Holston, French Broad, Clinch and Tennessee Rivers and Bullrun Creek. Much of the acreage of these soils is well suited to crops and a great part is used for this purpose. The areas on first bottoms are subject to flooding, although those along the four rivers have been largely freed of this hazard by dams upstream designed to retain floodwaters.

About 20 percent of the county has a steep surface, with slopes of more than 25 percent; 25 percent has a hilly surface, with slopes from 12 to 25 percent. In great part, these steep and hilly soils are on uplands, and a large acreage is shallow to bedrock. On the whole these soils are not well suited to cultivation, and in large part the steep shallow areas are suitable only to forest. Approximately 30 percent of the county has a rolling surface ranging from 5 to 12 percent; 17 percent has an undulating surface ranging from 2 to 5 percent; and 8 percent is nearly level. Soils of these three slope groups are predominantly fair to excellent for crops, although stoniness, compactness, and shallow depth to bedrock make a notable acreage poorly suited to this use. Practically all the soils of the first bottoms are nearly level. Most of those on stream terraces, on foot slopes, and along drains are undulating and rolling. Soils on the uplands range from undulating to steep.

The surface or plow layers of a great part of the soils have textures ranging from loam to silty clay loam. Silt loams and silty clay loams predominate in the soils developed over limestone; loams and clay loams in the Tellico-Neubert soil association; and fine sandy loams and clay loams in the Muskingum-Lehew soil association. Many of the soils on colluvium adjacent to the Muskingum-Lehew association have loam or fine sandy loam surface layers. A notable part of the acreage on the broader first bottoms has a loam or fine sandy loam texture. A very small amount of loamy fine sand is included with Staser fine sandy loam. The severely eroded Colbert soil, as well as some of the severely eroded Talbott soil, has a silty clay or clay plow layer. Practically all of the silty clay loam and clay loam soils are former areas of silt loams and loams, respectively, that have lost through erosion either all or a considerable part of their original surface layers.

Various degrees of stoniness are common over much of the county. About 50 percent of the soil area is stone-free or at least not stony enough to materially interfere with tillage. Almost all the soils on first bottoms are stone-free, and much of the acreage on stream terraces and in the Decatur-Dewey-Emory, the Fullerton-Bolton-Clarksville, the Tellico-Neubert, and the Sequoia-Leadvale soil associations are practically stone-free. About 39 percent of the county is occupied by soil sufficiently stony to interfere materially with but not to prevent tillage. Much of this soil is in the Fullerton-Bolton-Clarksville, the Dandridge-Litz-Leadvale, the Armuchee-Leadvale, and the Montevallo soil associations. Parts of the high stream terraces (Cumber-

land, Waynesboro, and Nolichucky soils) have cobblestones that interfere materially with tillage. Almost 11 percent of the county is so stony that tillage is impractical. Stoniness makes areas of the Stony land-Talbott and the Muskingum-Lehew soil associations unfit even for grazing. Less extensive areas too stony for practical cultivation are in the Sequoia-Leadvale, the Sequoia-Litz-Dandridge, the Dandridge-Litz-Leadvale, the Tellico-Neubert, the Sequoia-Bland-Leadvale, and the Bland-Camp soil associations.

Depth to bedrock ranges from practically nothing to more than 20 feet. Soils having depths of more than 5 feet occupy about 57 percent of the county. A great part of the soils on first bottoms, stream terraces, and practically all of the Decatur, Dewey, Fullerton, and Clarksville soils are well over 5 feet deep. In places soils on foot slopes and along drains have bedrock within less than 5 feet of the surface, but a large part has greater depth. Soils having depths ranging from about 18 inches to 5 feet make up almost 14 percent of the county. The Sequoia and Talbott and a notable proportion of the soils on foot slopes and along drains are of this thickness. The rest of the county is occupied mainly by soils having an average depth to bedrock of less than 20 inches; chief among these are the Dandridge, Litz, Montevallo, Armuchee, Bland, Muskingum, and Lehew soils. The stony land types have an average depth to bedrock of less than 18 inches; the limestone-rockland miscellaneous land types have bedrock at the surface over a great part of their area.

On a large acreage of the soils permeability is favorable for the crops commonly grown. The Huntington, Congaree, Staser, Etowah, Neubert, Alcoa, Emory, Abernathy, and Greendale soils have the most favorable moisture relations. The capacity to hold moisture available to crops is somewhat restricted in many of the other soils deep to bedrock and is notably limited in those soils shallow to bedrock.

About 15 percent of the acreage of the county is high in natural fertility, 47 percent moderate, and 38 percent rather low. The most fertile soils are the Huntington, Lindside, Congaree, Chewacla, Emory, Abernathy, Ooltewah, Neubert, Alcoa, Etowah, Cumberland, Decatur, Dewey, and Farragut. A great part of their acreage is in the Cumberland-Huntington and the Decatur-Dewey-Emory soil associations (pl. 2, *A* and *B*). The associations consisting predominantly of soils of low fertility are the Muskingum-Lehew, the Montevallo, and the Jefferson-Montevallo.

In the agriculture commonly practiced, about 51 percent of the county acreage is suited to crops that require tillage (First-, Second-, and Third-class soils). About 25 percent is not suited to crops but suitable for pasture (Fourth-class soils). Approximately 24 percent is poorly suited to either crops or pasture (Fifth-class soils). The 51 percent suited to crops requiring tillage is divided as follows: 6 percent, very well suited (First-class soils); 28 percent, well suited (Second-class soils); and 17 percent, fairly well suited (Third-class soils).

First- and Second-class soils predominate in the Cumberland-Huntington, the Staser-Hamblen, and the Decatur-Dewey-Emory soil associations; Second-, Third-, and Fourth-class soils in the Fullerton-Bolton-Clarksville and the Sequoia-Leadvale; Fourth-class soils in the Armuchee-Leadvale, the Dandridge-Litz-Leadvale, and the Stony land-Talbott; and Fifth-class soils in the Muskingum-Lehew and the Bland-Camp soil associations.

The soil series of Knox County are grouped in table 2 according to their position on the landscape, and some of their distinguishing characteristics are given. Of the five soil series on uplands common to the limestone valleys, the Decatur and Dewey are the most important. They are recognized by their red subsoils, generally great depth to bedrock, and relatively high natural fertility. They are among the most desirable soils for the production of crops and pasture. The Talbott, Colbert, and Bland soils are more clayey and have a heavier consistence than the Decatur and Dewey soils. They are notably shallower to bedrock and have a lower fertility. The Talbott soils are distinguished from the Colbert in having a red rather than yellow clay subsoil and average a little deeper to bedrock. The Bland soils are distinguished by their dusky-red color. They are not limited to limestone valley positions, as a large part of their acreage is on steep rugged ridges, so strongly sloping and shallow to bedrock in many places as to be poorly suited to cultivation.

The Fullerton, Clarksville, and Bolton soils are on gravelly or cherty ridges and, like the Decatur and Dewey soils, are interassociated in many places. In general, however, the Clarksville soils are more common along the northwestern parts of the cherty ridge belts. On the whole, the Fullerton acreage predominates on these ridges, whereas the Bolton soils are limited to areas of 5 to 40 acres, which are numerous and widely distributed. All of these soils are deep to bedrock limestone, most of which is dolomitic. The Fullerton soils are distinguished by their reddish-yellow subsoil, and the Clarksville by their yellow subsoil. The Bolton soils are distinguished by their decidedly brown surface soil, those of the Clarksville and Fullerton being comparatively gray. The Clarkesville soils are notably low in fertility, the Fullerton are moderate, and the Bolton approach the higher fertility of the Dewey.

The Farragut, Montevallo, much of the Sequoia, and some of the Litz and Dandridge soils occupy the upland parts of the shale valleys. The Farragut soils have surface layers and sublayers to a depth of 18 or 20 inches similar to those of the Decatur. They differ in that they have shale at a depth of 1½ to 4 feet, whereas the Decatur soils are underlain by limestone at a greater depth. The Sequoia soils have lighter colored surface soils and subsoils than the Farragut and are less fertile, although under good management they are productive. The Litz, Dandridge, and Montevallo soils are very shallow to shale, and the surface layer commonly has at least a moderate amount intermixed. All are of low fertility, but of the three, the Dandridge is the most productive.

The Dandridge, Litz, and Armuchee soils of the shale hills are all shallow to bedrock and have hilly to steep slopes. The Dandridge and Litz areas are so intricately intermixed that they are mapped together. The Dandridge soils are shallow to calcareous (limy) shale bedrock, whereas the Litz soils rest on leached (soft) shale to depths ranging from 4 to 8 feet, under which there is generally calcareous shale. The Armuchee soils are underlain by interbedded limestone and shale. Soils of all three series, though not well suited to cultivation, are moderately productive of the common pasture grasses and legumes.

TABLE 2.—*Distinguishing characteristics of soil series in Knox County, Tenn.*

SOILS ON UPLANDS

Topographic position and soil series	Parent rock or parent material	Description	Dominant relief
Limestone valleys:			
Decatur	High grade limestone	Dark-brown surface soil; brownish-red silty clay subsoil.	Undulating to hilly.
Dewey	do	Grayish-brown surface soil; yellowish-red silty clay subsoil.	Undulating to steep.
Talbott	Clayey (argillaceous) limestone	Grayish-brown surface soil; red plastic clay subsoil.	Undulating to hilly.
Colbert	do	Brownish-gray surface soil; yellow very plastic clay subsoil.	Do.
Bland	Dusky-red [1] shaly limestone	Dusky-red surface soil; dusky-red silty clay subsoil.	Rolling to hilly.
Steep purplish limestone ridges:			
Bland	do [1]	do	Hilly to steep.
Cherty ridges (gravelly or cherty ridge lands):			
Fullerton	Moderately cherty limestone	Brownish-gray surface soil; reddish-yellow moderately cherty silty clay subsoil.	Undulating to steep.
Clarksville	Very cherty limestone	Gray surface soil; brownish-yellow very cherty silty clay subsoil.	Rolling to steep.
Bolton	Sandy limestone or limestone with thin sandy layers.	Dark-brown surface soil; reddish-brown silty clay loam to silty clay subsoil.	Do.
Shale valleys:			
Sequoia	Interbedded shale and limestone or calcareous (limy) shale.	Brownish-gray surface soil; reddish-yellow silty clay subsoil.	Undulating to hilly.
Farragut	High grade limestone over acid shale.	Brown surface soil; reddish-brown silty clay subsoil.	Do.
Montevallo	Acid shale	Yellowish-gray surface soil; brownish-yellow very shaly silty clay loam subsoil.	Undulating to steep.
Litz	Leached shale or shale interbedded with some limestone.	Yellowish-gray surface soil; brownish-yellow shaly silty clay loam subsoil.	Hilly to steep.

Shale hills:			
Dandridge	Calcareous (limy) shale (blue slate land).	Grayish-yellow surface soil; brownish-yellow shaly silty clay loam subsoil.	Do.
Litz	Leached shale	Yellowish-gray surface soil; brownish-yellow shaly silty clay loam subsoil.	Do.
Armuchee	Interbedded limestone and shale	Brownish-gray surface soil; yellowish-red and yellow silty clay subsoil.	Do.
Steep sandy and shaly ridges:			
Lehew	Dusky-red sandy shale	Weak-red surface soil; weak- to dusky-red friable clay loam subsoil.	Do.
Muskingum	Sandstone or interbedded sandstone and shale.	Brownish-gray surface soil; light-yellow stony sandy loam or loam subsoil.	Do.
Red sandy ridges:			
Tellico	Calcareous sandstone	Light reddish-brown surface soil; dark-red sandy clay subsoil.	Rolling to steep.
Soils on Foot Slopes and Along Drains			
Drainheads and drainageways in limestone valleys:	Colluvium and local alluvium chiefly from—		
Emory	Decatur, Dewey, and Farragut soils.	Brown surface soil; light reddish-yellow to yellowish-brown silty clay loam subsoil.	Undulating to rolling.
Drainheads and drainageways in cherty ridges:			
Greendale	Fullerton and Clarksville soils	Brownish-gray surface soil; light brownish-yellow to yellowish-brown silty clay loam subsoil.	Do.
Sinkholes in limestone valleys and on cherty ridges:			
Abernathy	Decatur, Dewey, and Farragut soils.	Brown or reddish-brown surface soil; reddish or yellowish-brown silt loam subsoil.	Nearly level.
Ooltewah	Decatur, Dewey, Farragut, Fullerton, and Clarksville soils.	Grayish-brown to brown surface soil; yellowish-brown mottled below 18 to 24 inches.	Do.
Guthrie	Fullerton, Talbott, Colbert, and Sequoia soils.	Gray surface soil; gray, mottled with yellow and brown, clay subsoil.	Do.

[1] Commonly called purplish-red or Indian red.

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TABLE 2.—*Distinguishing characteristics of soil series in Knox County, Tenn.*—Continued

SOILS ON FOOT SLOPES AND ALONG DRAINS

Topographic position and soil series	Parent rock or parent material	Description	Dominant relief
Drainageways and foot slopes below steep dusky-red limestone:			
Camp	Bland soils	Weak-red to dusky-red surface soil; dusky-red silty clay loam subsoil.	Gently sloping to sloping.
Relatively high foot slopes below steep sandy shaly ridges:			
Jefferson	Muskingum and Lehew soils	Grayish-yellow surface soil; brownish-yellow clay loam subsoil.	Undulating to rolling.
Drainheads and drainageways below steep sandy and shaly ridges:			
Cotaco	Muskingum, Lehew, and Jefferson soils.	Yellowish-gray surface soil; mottled yellow, gray, and brown clay loam subsoil.	Do.
Drainheads and drainageways in shale valleys and hills:			
Leadvale	Dandridge, Armuchee, Sequoia, Litz, Montevallo, Muskingum, and Lehew soils.	Gray surface soil; yellow grading to mottled silty clay loam subsoil.	Do.
Whitesburg	Dandridge, Armuchee, Litz, and Sequoia soils.	Brownish-gray surface soil; yellow grading to mottled silt loam or silty clay loam subsoil.	Do.
Relatively high foot slopes below red sandy ridges:			
Alcoa	Tellico soils	Brown surface soil; yellowish-red silty clay loam subsoil.	Do.

Drainheads and drainage-ways below red sandy hills:			
Neubert	do	Reddish-brown surface soil; brownish-red clay loam subsoil.	Do.
Soils on Stream Terraces			
High stream terraces:			
Cumberland	Mixed alluvium strongly influenced by limestone.	Brown surface soil; red silty clay subsoil	Undulating to hilly.
Waynesboro	Mixed alluvium from shale, sandstone, and limestone.	Grayish-brown surface soil; red sandy clay subsoil.	Do.
Nolichucky	do	Gray surface soil; reddish-yellow sandy clay subsoil.	Rolling.
Moderately high stream terraces:			
Etowah	Mixed alluvium strongly influenced by limestone.	Grayish-brown surface soil; yellowish-brown, with a reddish cast, silty clay loam subsoil.	Undulating to hilly.
Tyler	Mixed alluvium from shale, sandstone, and limestone.	Light-gray surface soil; mottled gray and yellow clay subsoil.	Nearly level.
Low stream terraces:			
Wolftever	Mixed alluvium from limestone, shale, and sandstone.	Light-brown surface soil; light yellowish-brown compact silty clay subsoil.	Undulating to rolling.
Sequatchie	Predominantly sandy alluvium	Grayish-brown surface soil; brownish-yellow sandy clay loam subsoil.	Do.
Soils on First Bottoms			
Huntington	Mixed alluvium apparently strongly influenced by limestone.	Brown surface soil; brown or yellowish-brown subsoil.	Nearly level.
Lindside	do	Brown surface soil; mottled silty clay loam subsoil.	Do.

TABLE 2.—*Distinguishing characteristics of soil series in Knox County, Tenn.*—Continued

SOILS ON FIRST BOTTOMS—Continued

Topographic position and soil series	Parent rock or parent material	Description	Dominant relief
Melvin	Mixed alluvium apparently strongly influenced by limestone.	Brownish-gray surface soil; mottled gray and yellow silty clay subsoil.	Nearly level.
Roane	Alluvium from Clarksville and Fullerton soils.	Grayish-brown cherty surface soil; yellowish-brown or yellowish-gray cherty compact silty clay loam subsoil.	Do.
Staser	Mixed alluvium derived chiefly from shale, much of which was calcareous or limy.	Grayish-brown surface soil; yellowish-brown fine sandy loam to silt loam subsoil.	Nearly level to very gently undulating.
Hamblen	do	Light yellowish-brown surface soil; mottled gray, brown, and yellow silty clay loam subsoil.	Nearly level.
Prader	do	Light-gray surface soil; light-gray somewhat mottled clay subsoil.	Do.
Congaree	Mixed alluvium, much of which was derived from micaceous rocks.	Brown surface soil and subsoil with much mica throughout.	Nearly level to very gently undulating.
Chewacla	do	Brown surface soil; mottled gray, yellow, and brown subsoil.	Nearly level.

The Lehew and Muskingum soils, like the Dandridge, Litz, and Armuchee, are shallow to bedrock and have hilly to steep slopes. Their parent rocks, however, are acid or low in lime, and the soils are much less productive of pasture or crops than the Dandridge, Litz, and Armuchee. Soils of the Lehew and Muskingum series occur intermixed on the steep sandy shale ridges, such as Sharp and Beaver Ridges. Muskingum soils occupy all of House Mountain.

The Tellico soils are dusky-red sandy soils on the steep rugged ridges, such as Brown Mountain southeast of Knoxville. The range in depth to bedrock is greater than for the shale-hill soils, and the smoother parts, though limited in extent, are well suited to cultivation. The color of the Tellico soils somewhat resembles that of the Decatur, but the subsoil is much more friable and permeable and the natural fertility is lower.

Of the soils occurring on foot slopes and along drains, those on local alluvium and colluvium—the Emory, Greendale, Camp, Abernathy, Ooltewah, and Guthrie—consist of material derived chiefly from limestone. The Abernathy, Ooltewah, and Guthrie occupy sinkholes and differ from each other chiefly in degree of drainage. The Abernathy has the best drainage, and the Guthrie the poorest.

Emory soils are associated chiefly with Decatur, Dewey, and Farragut soils and usually lie on gentle foot slopes around sinkholes occupied by Abernathy soils. The Abernathy and Emory soils are among the most productive in the county and are suited to a wide variety of crops, although crops on the Abernathy are damaged at times by temporary flooding.

The Greendale soils, like the Emory, occupy foot slopes but consist of the somewhat less fertile local alluvium washed from the Fullerton and Clarksville soils. They are more yellowish than the Emory soils. The Camp series includes the dusky-red soils on foot slopes of local alluvium associated with the Bland soils. Though rather high in clay, they are well suited to crops and are productive of most crops commonly grown.

Jefferson and Cotaco soils consist of local alluvium and colluvium from the Muskingum and Lehew. The Jefferson soils are older than the Cotaco, occupy the more rolling higher foot slopes adjacent to Muskingum and Lehew ridges, and are well drained. In contrast, the Cotaco soils consist of young more gently sloping alluvium along the drainageways leading out from these ridges and have slow internal drainage as indicated by their mottled subsoil. In large part, Cotaco and Jefferson soils are suited to crops, but their natural fertility is much lower than that of the Emory soils.

The Leadvale and Whitesburg soils consist of local alluvium and colluvium from shale areas. The Leadvale occupies the higher, older, more sloping areas, and the Whitesburg the narrow strips of young alluvium along the drainageways. They occupy the local alluvial areas throughout the shale ridges and valleys and were mapped together as phases of Leadvale and Whitesburg silt loams. The Whitesburg soils are distinguished by their slightly acid to slightly alkaline reaction, as compared with the more acid reaction of the Cotaco, Jefferson, and Leadvale series.

The Alcoa and Neubert soils consist of local alluvium and colluvium from Tellico soils. The Alcoa is the older and occupies the more rolling, higher foot slopes adjacent to the Tellico ridge lands. The

Neubert soils lie as gently sloping strips at drain heads and along the upper reaches of the drainageways. Both soils are friable and permeable and have better internal drainage than the Leadvale, Cotaco, and Whitesburg soils. They are productive and among the most desirable soils for crops.

The Cumberland and Etowah are well-drained silty soils on the older stream terraces. They are classified with those soils of the stream terraces that consist predominantly of limestone material or have been strongly influenced by it. The Cumberland approximate the Dewey soils in color. In places they are as brown in the surface soil and as red in the subsoil as the Decatur soils. The Etowah soils are somewhat less brown in the surface soil and less reddish in the subsoil and are more friable than the Cumberland. In general they occupy somewhat lower positions, the Cumberland occupying chiefly the highest stream terraces. Both of these soils are fertile and much of their acreage is good cropland.

Like the Cumberland and Etowah, the Waynesboro and Nolichucky soils are well drained. They differ chiefly in being noticeably more sandy and are classed as a mixed general alluvium to which sandstones or other sand-bearing rocks have made a large contribution. Both occupy high stream terraces comparable to those on which Cumberland soils occur. The Waynesboro has a browner surface soil and a redder subsoil and is more fertile than the Nolichucky. Much of their aggregate area is suited to crops.

The Tyler soil represents the poorly or very poorly drained soils on stream terraces. It is associated with soils of the lower terraces; very little or no acreage is associated with the Cumberland, Waynesboro, and Nolichucky of the high stream terraces. It also includes the very poorly drained areas on local alluvium in the shale valleys, where it is associated with Leadvale and Whitesburg soils. The Tyler soil is poorly suited to most crops that require tillage.

Wolftever and Sequatchie soils occupy low stream terraces and are mostly located along the Holston, French Broad, Clinch, and Tennessee Rivers. Wolftever soils are moderately fertile but have a rather compact subsoil; their internal drainage in most places is somewhat impaired, and the soil may be subject to occasional flooding. Sequatchie soils are sandy and permeable. Wolftever and Sequatchie soils are well suited to crops requiring tillage.

The Huntington, Roane, Staser, and Congaree are well-drained soils on first bottoms along the Tennessee River, which carries micaceous sediments from the Blue Ridge physiographic province. The Congaree is distinguished by its high content of mica, as it consists chiefly of alluvium originating from schist, gneiss, and granite. The Chewacla is an imperfectly drained soil associated with the Congaree.

The Huntington soils, located mainly along the Holston River, are distinguished by their rich-brown color and friable silt loam texture. Their parent alluvium is thought to consist largely of material originating from limestone, although considerable amounts of shale and sandstone are intermixed.

Lindside and Melvin soils are the imperfectly and poorly drained soils, respectively, that are associated with the Huntington. They occupy a large part of the first bottoms along creeks that drain wholly or in part from soils over limestone. Very little alluvium along these creeks is sufficiently well drained to be classified as Huntington soil.

The Huntington and Lindside soils are among the most fertile soils of the county.

The Roane soils border creeks carrying sediments from the more extensive areas of Fullerton and Clarksville soils. They are moderately well drained, contain more chert, and are lower in fertility than the Huntington soils. In places, the cherty substratum is partly cemented.

The Staser, Hamblen, and Prader soils consist chiefly of alluvium of shale and mixed shale and sandstone origin that is slightly acid to slightly alkaline. Much of this alluvium originated from calcareous shales or interbedded shale and limestone. The Staser soils are well drained and are lighter brown and average lower in fertility than the Huntington. The Hamblen soils are imperfectly drained and the Prader soils are poorly drained.

SOIL TYPES AND PHASES

In this section the various soils of the county are described in detail and their relation to agriculture—including present use and management, use suitability, and management requirements—are set forth as far as present knowledge permits. The acreage and proportionate extent of each soil are given in table 3, and its location and distribution are represented on the detailed soil map that accompanies this report.

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

Soil	Acres	Percent
Alcoa silt loam:		
Eroded rolling phase	193	0.1
Eroded undulating phase	334	.1
Armuchee silt loam, steep phase	2,261	.7
Armuchee silty clay loam:		
Eroded hilly phase	415	.1
Eroded steep phase	754	.2
Bland silt loam:		
Rolling phase	139	(1)
Steep phase	1,115	.3
Bland silty clay loam:		
Eroded hilly phase	581	.2
Eroded rolling phase	559	.2
Eroded steep phase	682	.2
Bolton silt loam:		
Eroded hilly phase	1,227	.4
Eroded rolling phase	2,356	.7
Eroded steep phase	528	.2
Bolton silty clay loam:		
Severely eroded hilly phase	1,186	.4
Severely eroded rolling phase	244	.1
Severely eroded steep phase	851	.3
Camp silt loam	210	.1
Chewacla silt loam	271	.1
Clarksville cherty silt loam:		
Eroded hilly phase	2,420	.7
Eroded rolling phase	3,120	.9
Eroded steep phase	1,118	.3
Hilly phase	2,900	.9
Rolling phase	2,864	.9
Steep phase	7,733	2.3

See footnote at end of table.

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

Soil	Acres	Percent
Colbert silty clay:		
Severely eroded hilly phase	282	.1
Severely eroded rolling phase	512	.1
Colbert silty clay loam:		
Eroded rolling phase	464	.1
Eroded undulating phase	198	.1
Congaree fine sandy loam	390	.1
Low-bottom phase	447	.1
Congaree silt loam	783	.2
Low-bottom phase	92	(1)
Cumberland gravelly fine sandy loam, eroded rolling phase	299	.1
Cumberland silty clay loam:		
Eroded hilly phase	439	.1
Eroded rolling phase	978	.3
Eroded undulating phase	295	.1
Severely eroded hilly phase	269	.1
Severely eroded rolling phase	124	(1)
Dandridge and Litz shaly silt loams:		
Eroded hilly phases	9,797	3.0
Eroded steep phases	2,834	.9
Dandridge and Litz silt loams:		
Hilly phases	1,224	.4
Steep phases	2,352	.7
Dandridge shaly silt loam:		
Eroded hilly phase	934	.3
Eroded steep phase	812	.2
Dandridge silt loam, steep phase	576	.2
Decatur silt loam:		
Rolling phase	136	(1)
Undulating phase	377	.1
Decatur silty clay loam:		
Eroded hilly phase	305	.1
Eroded rolling phase	2,606	.8
Eroded undulating phase	1,556	.5
Severely eroded hilly phase	636	.2
Severely eroded rolling phase	328	.1
Dewey silt loam:		
Rolling phase	153	(1)
Undulating phase	227	.1
Dewey silty clay loam:		
Eroded hilly phase	953	.3
Eroded rolling phase	5,504	1.7
Eroded steep phase	180	(1)
Eroded undulating phase	1,257	.4
Severely eroded hilly phase	1,831	.6
Severely eroded rolling phase	959	.3
Emory and Abernathy silt loams	1,165	.4
Emory silt loam:		
Rolling phase	1,207	.4
Undulating phase	9,076	2.8
Etowah silt loam, undulating phase	208	.1
Etowah silty clay loam:		
Eroded hilly phase	179	(1)
Eroded rolling phase	1,086	.3
Eroded undulating phase	907	.3
Severely eroded hilly phase	238	.1
Farragut silty clay loam:		
Eroded hilly phase	167	(1)
Eroded rolling phase	658	.2
Eroded undulating phase	421	.1

See footnote at end of table.

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

Soil	Acres	Percent
Fullerton cherty silt loam:		
Eroded hilly phase	4, 596	1. 4
Eroded rolling phase	6, 813	2. 1
Eroded steep phase	3, 853	1. 2
Hilly phase	3, 545	1. 1
Rolling phase	2, 143	. 7
Steep phase	6, 028	1. 8
Fullerton cherty silty clay loam:		
Severely eroded hilly phase	2, 484	. 8
Severely eroded rolling phase	505	. 1
Severely eroded steep phase	1, 583	. 5
Fullerton loam:		
Eroded hilly phase	1, 062	. 3
Eroded rolling phase	4, 074	1. 2
Eroded undulating phase	224	. 1
Hilly phase	188	. 1
Rolling phase	373	. 1
Undulating phase	187	. 1
Fullerton silt loam:		
Eroded hilly phase	5, 406	1. 6
Eroded rolling phase	11, 774	3. 6
Eroded undulating phase	1, 014	. 3
Hilly phase	1, 091	. 3
Rolling phase	1, 208	. 4
Undulating phase	327	. 1
Fullerton silty clay loam:		
Severely eroded hilly phase	3, 979	1. 2
Severely eroded rolling phase	929	. 3
Greendale cherty silt loam:		
Rolling phase	335	. 1
Undulating phase	255	. 1
Greendale silt loam:		
Rolling phase	1, 568	. 5
Undulating phase	8, 451	2. 6
Gullied land:		
Armuchee and Litz soil materials	8, 435	2. 6
Fullerton and Talbott soil materials	3, 989	1. 2
Sequoia and Montevallo soil materials	1, 299	. 4
Talbott and Decatur soil materials	492	. 1
Tellico and Muskingum soil materials	2, 182	. 7
Guthrie silt loam	644	. 2
Hamblen fine sandy loam	1, 713	. 5
Hamblen silt loam	1, 190	. 4
Huntington silt loam	779	. 2
Low-bottom phase	130	(1)
Jefferson and Montevallo clay loams severely eroded rolling phases	1, 035	. 3
Jefferson and Montevallo loams:		
Eroded rolling phases	1, 963	. 6
Eroded undulating phases	577	. 2
Jefferson loam, eroded rolling phase	1, 282	. 4
Leadvale and Cotaco loams:		
Rolling phases	506	. 1
Undulating phases	4, 247	1. 3
Leadvale and Whitesburg silt loams:		
Rolling phases	536	. 2
Undulating phases	13, 203	4. 0
Limestone rockland:		
Rolling and hilly	2, 776	. 8
Steep	1, 739	. 5

See footnote at end of table.

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

Soil	Acres	Percent
Lindside silt loam	9,716	2.9
Made land	1,060	.3
Melvin silt loam	2,733	.8
Montevallo shaly silt loam:		
Eroded hilly phase	1,225	.4
Eroded rolling phase	1,719	.5
Eroded steep phase	213	.1
Eroded undulating phase	482	.1
Montevallo silt loam, steep phase	136	(1)
Muskingum-Lehew fine sandy loams:		
Eroded hilly phases	3,573	1.1
Eroded steep phases	2,286	.7
Hilly phases	373	.1
Steep phases	12,760	3.9
Muskingum stony fine sandy loam, steep phase	476	.1
Neubert loam:		
Rolling phase	859	.3
Undulating phase	895	.3
Nolichucky gravelly loam, eroded rolling phase	545	.2
Ooltewah silt loam	1,284	.4
Prader silt loam	626	.2
Roane silt loam	1,942	.6
Sequatchie fine sandy loam	618	.2
Sequoia-Bland silty clay loams:		
Eroded hilly phases	208	.1
Eroded rolling phases	1,641	.5
Eroded undulating phases	1,301	.4
Severely eroded hilly phases	756	.2
Severely eroded rolling phases	1,186	.4
Sequoia silt loam:		
Rolling phase	787	.2
Undulating phase	813	.2
Sequoia silty clay loam:		
Eroded rolling phase	9,701	2.9
Eroded undulating phase	7,918	2.4
Severely eroded rolling phase	7,112	2.2
Severely eroded undulating phase	453	.1
Staser fine sandy loam	275	.1
Low-bottom phase	140	(1)
Staser silt loam	933	.3
Stony hilly and steep land, Colbert and Talbott soil materials	10,867	3.3
Stony rolling land, Colbert and Talbott soil materials	5,627	1.7
Stony very steep land, Muskingum soil material	807	.2
Talbott silty clay loam:		
Eroded rolling phase	1,007	.3
Eroded undulating phase	318	.1
Severely eroded hilly phase	384	.1
Severely eroded rolling phase	327	.1
Tellico clay loam:		
Severely eroded hilly phase	1,762	.5
Severely eroded rolling phase	641	.2
Severely eroded steep phase	2,559	.8
Tellico loam:		
Eroded hilly phase	2,088	.6
Eroded rolling phase	3,279	1.0
Eroded steep phase	1,543	.5
Hilly phase	644	.2
Rolling phase	276	.1
Steep phase	4,942	1.5

See footnote at end of table.

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

Soil	Acres	Percent
Tyler silt loam	176	(1)
Waynesboro clay loam, severely eroded hilly phase	252	0.1
Waynesboro loam:		
Eroded hilly phase	460	.1
Eroded rolling phase	968	.3
Eroded undulating phase	217	.1
Wolftever silty clay loam:		
Eroded rolling phase	135	(1)
Eroded undulating phase	382	.1
Total land area	329,600	100.0

[1] Less than 0.1 percent.

Alcoa silt loam, eroded undulating phase (2–5% slopes) (AB).—This soil occurs on foot slopes in the general vicinity of higher lying steep and hilly areas of Tellico soils and is composed of colluvium or local alluvium washed from those soils. It is associated with Sequoia and Litz soils of the shale valleys. All of the areas are in the southeastern part of the county, roughly south and east of United States Highway No. 70. The soil has a brownish-red surface where cultivated or bare. A large part is so eroded that much of the plow layer consists of a mixture of original surface and subsoil material. Internal drainage is medium.[4]

Profile description:

0 to 5 inches, reddish-brown silt loam.
5 to 30 inches, yellowish-red firm but friable silty clay loam.
30 inches +, variegated brown, yellow and gray soft weathered shale with harder less weathered shale a few feet below.

The depth to the shaly material ranges from 3 to about 8 feet in most places. Where erosion has not been active, the surface layer is 7 to 12 inches of brown, mellow silt loam.

The reaction is medium to strongly acid, and the natural fertility is moderately high. The soil is easily permeable down to the underlying shale and has large capacity for holding moisture available to plants.

Use and management.—All of this soil has been cleared and much of it is now used for crops, including corn, tobacco, small grains, lespedeza, and alfalfa. Little is either idle or used for pasture. It is a First-class soil,[5] although its productivity, workability, and conservability are a little lower than for a few other soils. It is well suited to a wide variety of crops, including truck crops and alfalfa. Moderately short rotations are suited, but care is required to avoid erosion. The more sloping parts will benefit from contour tillage and vigorous winter cover crops.

[4] "Medium" denotes optimum internal drainage for the production of commonly grown crops.

[5] See section on Use Suitability Groups for definitions of First-, Second-, Third-, Fourth-, and Fifth-class soils.

To maintain high fertility, regular fertilization is required. Lime and phosphorus appear to be the most immediate needs. Boron deficiency is commonly experienced with alfalfa. High yields of the commonly grown crops can be attained if organic matter and mineral plant nutrients are supplied in adequate amounts; legumes are grown regularly, especially as winter cover crops; and good tilth is maintained. Under a high level of management, the soil can produce 55 bushels of corn, 55 bushels of oats, and 3.8 tons of alfalfa. The soil produces good pasture. Where well fertilized, limed, and properly seeded and kept free of weeds, it is capable of producing 135 cow-acre-days of grazing.

Alcoa silt loam, eroded rolling phase (5–12% slopes) (AA).—This phase occupies rolling upland positions in association with the Sequoia and Litz soils. It is confined to those parts of the shale valleys adjacent to the steep Tellico ridges. As for the other Alcoa soil, it is limited to the southeastern part of the county.

Most of the acreage is moderately eroded. The plow layer consists of a mixture of the original surface soil and subsoil. Where the soil is not eroded, the surface layer is a brown silt loam from 6 to 12 inches thick. Below this is yellowish-red firm but friable silty clay loam subsoil. Variegated brown, yellow, and gray weathered shale is at depths ranging from 18 to 96 inches. In some places the original surface soil has been removed entirely by erosion and the plow layer is yellowish-red firm but friable silty clay loam. Usually the more eroded tracts are on the more sloping areas.

Surface runoff is rapid chiefly because of the slope. Internal drainage is medium. This soil is medium to strongly acid and low in organic matter in the more eroded parts. Although the soil is fertile, the more severely eroded parts have poor tilth and notably less favorable moisture relations.

Use and management.—Practically all of this soil has been cleared and much is now used for such crops as corn, tobacco, small grains, lespedeza, and alfalfa. Row crops are grown at relatively frequent intervals and continuing erosion losses are obvious on much of the acreage. Some fertilization is practiced, especially for the row crops, small grains, and alfalfa.

Chiefly because of its stronger slope, this is considered a Second-class soil. The more eroded parts are notably less productive. Organic matter is especially needed for the more eroded parts if high fertility is to be attained. Erosion control probably requires that close-growing crops occupy the soil at least the greater part of the time. Field operations on the contour and possibly strip cropping will aid in controlling runoff. Where a high level of management is practiced, oats will yield about 55 bushels an acre and alfalfa about 3.2 tons. Permanent pasture is well suited to this soil if high fertility is maintained. A good pasture stand can provide about 120 cow-acre-days of grazing.

Armuchee silty clay loam, eroded hilly phase (12–25% slopes) (AD).—This soil is closely associated with the steep Armuchee soils that dominate this landscape. It is limited to the Armuchee-Leadvale soil association, which is in a belt of shale hills between Copper Ridge on the southeast and Bullrun Creek on the northwest. Like other Armuchee soils, this phase is shallow to interbedded limestone and

shale, mostly of the Nolichucky geologic formation. The clayey subsoil and shallow depth to bedrock impair internal drainage, which, however, is entirely adequate for the needs of crops common to this county. This impaired drainage causes runoff to develop quickly during rains. Most of the areas have been eroded to the extent that the plow layer now consists partly or entirely of subsoil material.

Profile description:

0 to 5 inches, grayish-brown silty clay loam.
5 to 10 inches, brownish-yellow firm silty clay loam.
10 to 18 inches, yellowish-red very firm or plastic silty clay that has some yellow and gray intermixed in the lower part; limestone or shale bedrock at depths of 1 to 3 feet.

In places, especially where the soil is underlain by limestone, the surface soil is browner. On the other hand, in some places where shale is the underlying rock, the surface soil contains a notable amount of shale fragments and the subsoil is less plastic or firm. There are also a few thin ledgelike outcrops of limestone. Where erosion has removed practically all of the original surface layer, the plow layer now consists of yellowish-red very firm to plastic silty clay. The small acreage in a virgin condition, as under native forest, has a brownish-gray friable silt loam surface soil about 4 inches thick.

This soil is not very acid—in places the reaction is alkaline, or sweet. The natural fertility is medium and the content of organic matter is not high. Although percolation of moisture is retarded, the subsoil is not particularly resistant to root growth. The moisture available to plants is limited somewhat by the clayey subsoil and the shallow depth to bedrock. The most eroded parts have rather unfavorable moisture relations for plants.

Use and management.—Most of this soil has been cleared and used for crops at some time. Much of it is now in permanent pasture, a small amount is cropped, and some is idle. Corn, hay, and small grains are the chief crops grown. The permanent pastures consist mainly of bluegrass, white clover, lespedeza, crabgrass, Bermuda grass, and broomsedge. Pastures are not usually fertilized, and brush and other weedy growth are common in many places. The carrying capacity ordinarily is 50 cow-acre-days. On the uneroded parts, however, it is more nearly 80 cow-acre-days, and on the severely eroded parts it is very low.

Chiefly because of its strong slope, shallow depth to bedrock, and retarded percolation, this soil is not considered well suited to tilled crops. It is well suited to pasture. Under good management it produces herbage of good quality, such as bluegrass and clovers. Pastures will respond to phosphate but lime may not be required. Under good management the carrying capacity is about 85 cow-acre-days. Where this soil must be used for crops, exacting management is required to maintain productivity. Long rotations, fertilization adequate to maintain a luxuriant plant cover, and contour cultivation are among the required practices. In places mechanical means of diverting runoff may aid in restraining erosion. The most severely eroded parts are particularly unsuited for cultivation, as it is difficult to keep them productive.

Armuchee silt loam, steep phase (25+% slopes) (Ac).—This is the most extensive of the Armuchee soils. It occupies steep areas that

have not been materially eroded. The separate areas are rather large, or 25 to 160 acres or more in size. Like the other soils of this series, this phase is confined to the Armuchee-Leadvale soil association, which occupies a belt northwest of Copper Ridge. It has developed over interbedded limestone and shale. Slopes range from 25 to about 60 percent. Surface runoff is very rapid, and internal drainage is impaired.

Profile description:

0 to 3 inches, brownish-gray silt loam.
3 to 8 inches, brownish-yellow firm silty clay loam.
8 to 15 inches, yellowish-red very firm or plastic silty clay that has some yellow and gray intermixed in the lower part; limestone or shale bedrock at depths of a few inches to about 2½ feet.

In places, especially where this soil is underlain by limestone, the surface soil is browner. On the other hand, in places where shale is the underlying rock, the surface soil may contain a notable amount of shale fragments and the subsoil is less plastic. Ledgelike outcrops of limestone are a little more common than in the hilly Armuchee soils.

This soil is not very acid; in places the reaction is alkaline, or sweet. The natural fertility is medium, and the content of organic matter is not high. Although percolation of moisture is retarded, the subsoil is not particularly resistant to root growth. The capacity for holding moisture available to plants is limited by the clayey nature and the shallow depth to bedrock.

Use and management.—A great part of this soil is under native forest of deciduous hardwoods, including many oaks, with hickories, tuliptree, beech, maple, and other species intermixed. The steep slope and shallow depth to bedrock make this soil very poorly suited to crops. It is capable of supporting good pasture, as it is moderately fertile and most parts do not require lime. In general, where the forest cover is removed and brush and weedy growth is kept out, bluegrass and white clover develop a good volunteer cover. Pastures on this soil will respond to phosphorus fertilization; and if good management is practiced, a good pasture with a carrying capacity of 70 cow-acre-days can be maintained.

Armuchee silty clay loam, eroded steep phase (25+% slopes) (AE).—This phase comprises steep areas that occur in the Armuchee-Leadvale soil association area, which lies as a belt to the northwest of Copper Ridge. It is not so extensive as the steep phase but more so than the eroded hilly phase. A great many of the separate areas occupy from 80 to 150 acres.

The soil is eroded to the extent that the plow layer consists chiefly or wholly of subsoil material. This layer in most places is yellowish-red firm to plastic silty clay loam or silty clay. In the less eroded parts the plow layer may be grayish-brown firm silty clay loam. Bedrock shale or limestone is within 1 to 2 feet of the surface. Ledgy outcrops of limestone are not uncommon; most of them are indicated on the map by the appropriate symbol. Shale fragments are in the surface soil in places, and here weathered shale is at a shallow depth. The slopes are relatively long, and considerable water accumulates before reaching the base.

Most of this soil is not very acid, and in places it is alkaline or sweet. Its organic-matter content is lower than that of the uneroded

phase, and fertility is not quite so high. Tilth is less favorable, and the ability of the soil to absorb and hold moisture available to plants is a little lower, as the plow layer is more clayey and less friable.

Use and management.—All of this soil has been cleared and cropped. A large part is now used for pasture but some is idle. Practically none is cropped at present. When the soil was cropped, little fertilizer was used and row crops were grown rather frequently. Under this management crop yields were low after the major part of the surface soil had been lost.

Strong slopes, shallow depth to bedrock, unfavorable tilth, and slow permeability make this soil poor for crops. Under careful management, however, it can be made to respond when used for pasture. Organic matter and phosphorus are the chief fertility requirements; some areas may respond to lime, but usually it is not needed. Preparation of a good seedbed, proper fertilization and seeding, diversion of excess runoff, and removal of brush and weeds are requirements of good pasture management. Even under this management several years will elapse before a productive pasture capable of protecting the soil against erosion can be established. Where good pasture cover has been developed, a carrying capacity of about 40 cow-acre-days can be expected.

Bland silt loam, rolling phase (5–12% slopes) (BA).—All of this soil occurs with other Bland soils in the Bland-Camp soil association in that part of the county south of the French Broad River. Most of it lies on rolling ridge tops flanked by hilly to steep Bland soils. Like other Bland soils, this one developed over dusky-red (commonly called purplish red or Indian red) shaly limestone of the Bays geologic formation. In places, however, the limestone is of the Moccasin geologic formation. Where this formation is exposed and interassociated with Sevier shale (from which Sequoia soils developed), the Sequoia and Bland soils are so closely associated that they are mapped as Sequoia-Bland complexes. Natural drainage is adequate for most crops, but internal movement of moisture is somewhat impaired or retarded by the heavy compact subsoil and generally shallow depth to bedrock.

Profile description:

0 to 6 inches, weak-red silt loam.
6 to 18 inches, weak-red to dusky-red firm silty clay that is moderately plastic to plastic when wet; clods difficult to crush when dry, and the mass, when moderately moist, breaks into nutlike fragments.
18 to 36 inches, dusky-red very firm to plastic clay that breaks into larger lumps than the layer above; dusky-red shaly limestone bedrock at depths of 12 to 36 inches.

This soil is medium acid and has a moderate amount of organic matter in the surface layer. Although the subsoil has a heavy consistence and impairs free movement of moisture, root development is not greatly restricted.

Use and management.—Most of this soil is under native forest consisting of deciduous hardwoods, chiefly oaks. It is physically suited to the production of crops commonly grown, particularly small grains and hay crops, but because of its heavy clayey nature and rather shallow depth to bedrock, it is considered a Third-class soil. Chiefly

because of its heavy consistence, it is less desirable for many vegetables than some of the more friable soils.

If a high fertility is to be maintained, the soil must be regularly fertilized. Some areas may require no lime and others only a moderate amount. Since erosion is a hazard on most of the areas, 3- to 5-year rotations are necessary. Tillage should be on the contour, and in places mechanical means of taking care of excess runoff will be of value in maintaining this soil. Good pasture consisting of such plants as bluegrass, white clover, and orchard grass is not difficult to establish and maintain. Under a relatively high level of management that includes adequate fertilization and moderately long rotations in which legume hay and pasture crops predominate, yields of 30 bushels of corn, 2.6 tons of alfalfa, and 1.2 tons of lespedeza may be produced.

Bland silty clay loam, eroded rolling phase (5–12% slopes) (BD).—This soil comprises tracts, formerly of Bland silt loam, rolling phase, that have been so eroded that subsoil material is within plow depth for more than half the delineated area. Practically all of it is on rolling ridge tops flanked by hilly to steep Bland soils. All of the acreage is in the Bland-Camp soil association.

The surface layer in many places is dusky-red silty clay loam. Below this is the dusky-red silty clay subsoil material. On a large part of this soil, practically all of the original surface layer has been lost and the plow layer consists of the dusky-red clayey subsoil. Bedrock is at depths of 1 to 2½ feet. Runoff develops rapidly during rains, especially on the more eroded parts, and in places has caused shallow gullies. Internal drainage, or movement of soil moisture, is notably impaired.

Use and management.—All of this soil has been cleared and cropped. A small part is now idle, some is in permanent pasture, and more than half is used for crops, chiefly corn, small grains, lespedeza, redtop, and alfalfa. Small acreages of vegetables are grown. Some fertilizer is applied, especially for the row crops and alfalfa. Rotations are moderately short. Row crops are grown at frequent intervals on some of the soil. Little organic matter is returned to the soil in the form of barnyard manure or green-manure crops. Under this level of management, corn yields about 20 bushels; oats, 16 bushels; and lespedeza, 0.7 ton an acre.

This soil is capable of producing much better yields if properly managed. Needed are moderately long rotations, fertilization with phosphorus and organic matter, and the use of legumes. Particular care is required to control erosion. If long rotations consisting chiefly of close-growing crops are followed, contour cultivation will be necessary. Such practices as strip cropping and diversion of excess runoff may be feasible. If the productivity of this soil is raised to a relatively high level, corn may yield 28 bushels and alfalfa 2.5 tons an acre. The carrying capacity of pasture, under good management, should be about 75 cow-acre-days.

Bland silty clay loam, eroded hilly phase (12–25% slopes) (BC).—This soil, one of the most extensive of the Bland series, is widely distributed on ridge slopes throughout the Bland-Camp soil association in the southeastern part of the county. A great part of

it has been cleared and cropped at some time and much of it has been severely eroded. In these eroded areas the plow layer consists of dusky-red very firm silty clay subsoil material, and dusky-red shaly limestone bedrock is at depths of 1 to 2 feet. Shallow gullies are common but most of them can be crossed with farm machinery. Some areas less severely eroded have a more silty surface layer. The small amount of uneroded soil has a weak-red silt loam layer to a depth of about 5 inches. Practically all of the uneroded acreage is under native deciduous forest.

Internal drainage is somewhat impaired, and runoff water accumulates rapidly during rains. The natural fertility is medium, and the content of organic matter is not high. The reaction is medium acid.

Use and management.—A small part of this soil is used for crops, some is idle, some (about 10 percent) is forested, and the rest is in pasture or hay. Small grains and lespedeza-and-grass hay are the chief crops; corn, alfalfa, and vegetables are produced less extensively. Under common management corn receives little or no fertilizer but small grains receive 75 to 125 pounds of 20-percent phosphate or its equivalent, or 0–10–4[6] fertilizer. Vegetables commonly receive 300 to 500 pounds of mixed fertilizer, and alfalfa 2 to 3 tons of lime and 200 to 300 pounds of 2–10–4 fertilizer at the time of seeding. Pastures commonly consist of bluegrass, other grasses, such as crabgrass, hop clover, white clover, and broomsedge. Lime has been applied to some pastures at the rate of 2 to 3 tons an acre; fertilization is not generally practiced. Under ordinary conditions, corn yields about 16 bushels and lespedeza about 0.6 ton an acre.

Chiefly because of its strong slope, heavy soil material, and shallow depth to bedrock, this soil is considered poorly suited to crops. It is capable of producing good pasture if its fertility is kept fairly high and a good stand of desirable grasses and legumes is established. Phosphorus and organic matter are among the chief requirements for pasture, and lime may be needed on much of the acreage. Under favorable conditions the carrying capacity is about 70 cow-acre-days.

Bland silt loam, steep phase (25+% slopes) (Bb).—This phase covers steep areas of Bland silt loam that have not been materially eroded. It is one of the more extensive soils of the Bland series and is widely distributed throughout the Bland-Camp soil association.

The surface layer, about 4 inches thick, is weak-red to dusky-red silt loam. The subsoil is dusky-red firm to plastic silty clay. Dusky-red bedrock of shaly limestone is at depths reaching 2 feet. Rock outcrops in some places. The heavy shallow subsoil impairs percolation of water and causes rapid runoff. The natural fertility is medium, and the content of organic matter is not high. The reaction is slightly to medium acid.

Use and management.—Practically all of this soil is under native forest consisting almost wholly of deciduous hardwoods, among which oaks predominate. There are a few cedars and pines intermixed, as well as some hickory, tuliptree, and other deciduous trees. Chiefly because of its very strong slope and shallow depth to bedrock, this soil is very poorly suited to pasture. Under the most favorable man-

[6] Percentages of nitrogen, phosphorus, and potash, respectively.

agement, it might produce 60 cow-acre-days of grazing. This, however, would require great care in maintaining a plant cover to protect against erosion. Northern exposures can be expected to produce the best plant cover.

Bland silty clay loam, eroded steep phase (25+% slopes) (BE).—In this phase are areas formerly occupied by the steep phase that have lost much of the surface soil, and in places part of the subsoil, through erosion. This phase and the steep phase make up a large part of the Bland-Camp soil association.

The plow layer for much of this eroded steep phase consists of dusky-red very firm or moderately plastic silty clay loam. Dusky-red shaly limestone bedrock is at depths of 1 to 1½ feet. There are some outcrops of bedrock, which are indicated on the map by appropriate symbol. Small gullies are common but most of them can be crossed with farm machinery. The plow layer on the less eroded parts consists of a mixture of original silt loam surface soil with the more plastic clay subsoil. Percolation of moisture is slow, and as a result runoff develops quickly.

Use and management.—All of this phase has been cleared and cropped, but the cropped acreage is now small. Most of this soil is used as unimproved pasture, some is idle, and some is in volunteer pine forest. Pastures generally are of low quality, chiefly broomsedge, crabgrass, weeds, briers, and sassafras and persimmon sprouts. Steep slopes, slow permeability, and shallowness to bedrock make the soil poorly suited to either crops or pasture. Some of the more favorable parts, if properly fertilized, seeded, and protected from weeds and bushy growth, will produce fairly good grazing.

Bolton silt loam, eroded hilly phase (12–25% slopes) (BF).—This is a brown relatively fertile soil on cherty ridge slopes, mainly on those that face northeast or east. It has developed from sandy dolomitic limestone or limestone containing sandy layers. Though widely distributed throughout the Fullerton-Bolton-Clarksville soil association, this soil is less extensive than the eroded hilly soils of the Fullerton series. The separate areas range from 5 to 30 acres in size. Surface and subsoil layers resemble those of the Dewey and Decatur soils in color. This soil differs from those soils mainly in being more permeable and in generally containing a little more sand, though not enough to classify it as a sandy soil. Internal drainage is medium.

Profile description:

0 to 5 inches, dark-brown mellow loam to silt loam that has a fluffy or spongy feel.
5 to 14 inches, yellowish-brown or reddish-brown friable silty clay loam.
14 to 40 inches, reddish-brown firm but notably friable silty clay.
40 inches +, red firm but friable silty clay with faint gray, yellow, and brown mottles; some chert fragments; bedrock at depths of 15 to 30 feet.

In places, the subsoil is less red. Some dark-brown sandstonelike fragments are in much of this soil, and small dark-brown concretions are common in the subsoil layers. A moderate amount of chert occurs in places. The small acreage still under native forest has a brown silt loam surface layer 8 to 10 inches thick. On the other hand, small exposed patches in the cultivated areas have lost a great part or all of the original surface soil and have a plow layer of reddish-brown firm but friable silty clay.

This soil is medium to strongly acid and is moderately high in fertility—higher than Fullerton soils but a little lower than Decatur and Dewey soils. It is notably permeable, and runoff does not develop so quickly as on Decatur, Sequoia, and even the Fullerton soils. Although its tilth is not strikingly unfavorable, the soil resists scouring from tillage implements. Farmers speak of it as "push soil", as it tends to stick to plow moldboards and cultivator shovels. This same characteristic apparently causes the soil to heave when it freezes. Freezing is therefore somewhat more of a hazard to alfalfa, clovers, and fall-sown crops on this soil than on some others.

Use and management.—Most of this soil has been cleared and cropped. A small part is still under native forest of deciduous hardwoods, chiefly oaks, with maple, beech, tuliptree, and some shortleaf pine intermixed. Some of it is idle or under permanent pasture, but a large part is cultivated, principally to corn, small grains, and hay. Lespedeza, redtop, and wild grasses are the chief hay crops. A small acreage of vegetables is grown.

A common rotation is corn, a small grain, and then lespedeza and redtop for 2 or 3 years. Light applications of fertilizer are commonly used—75 to 125 pounds of 20-percent phosphate or the equivalent, or 0–10–4 or 2–10–2 mixed fertilizer. Vegetables receive fairly heavy applications, 500 to 1,000 pounds of a 3–9–5 or 2–12–6 fertilizer being common. Little manure is used, and turning under legume cover crops is not a common part of the management system. Lime has been applied to much of the soil at the rate of 2 to 3 tons an acre. Under common management corn yields 25 bushels, wheat 11 bushels, and lespedeza 0.8 ton an acre. Most pastures have a relatively low carrying capacity; little effort is made to improve them and the volunteer vegetation is not of as high quality.

This soil is suited to crops requiring tillage. It has fairly good tilth and moisture relations. Under a high level of management it is productive of a wide variety of crops. It is rated as a Third-class soil chiefly because its strong slope makes field work and control of runoff difficult. Long rotations lasting from 5 to 9 years and consisting chiefly of close-growing small grains and hay are well suited. Contour tillage is required, and excess runoff can be diverted by mechanical means to advantage in places. The advisability of terracing is questionable.

Phosphorus and lime are especially needed for starting and maintaining good stands of the common clovers and alfalfa. Barnyard manure or winter legume cover crops turned under are needed to maintain organic matter when crops are to be grown regularly. It is important that high fertility be maintained in order that plants will grow vigorously and protect the soil from erosion. Where this soil is kept productive, lespedeza yields 1.5 tons, alfalfa 2.8 tons, and oats 40 bushels an acre. Under common management this soil produces less pasture than some soils but it will provide grazing of good quality if properly fertilized, seeded, and protected from brush and weeds. When so managed, its carrying capacity is about 100 cow-acre-days.

Bolton silty clay loam, severely eroded hilly phase (12–25% slopes) (BK).—This soil covers areas formerly occupied by the hilly phase of Bolton silt loam that are now so eroded that the original surface soil and in places part of the subsoil have been lost. Though

not a predominant soil, it is widely distributed throughout the Fullerton-Bolton-Clarksville soil association, generally on northeast- and east-facing slopes. The plow-layer consists of reddish-brown or yellowish-brown silty clay loam or silty clay, and the subsoil is predominantly reddish-brown firm but friable silty clay. Limestone bedrock is at depths of 15 to 30 feet. There are a few gullies but most of them can be crossed by farm machinery.

Internal drainage is adequate for the crops commonly grown, although somewhat more impaired than for the less eroded Bolton soils. The capacity for holding moisture available to plants is fair, but lower than that of the uneroded soil of this series. The reaction is medium to strongly acid. The fertility is medium.

Use and management.—All of this soil has been cleared and cultivated. Much is now used for pasture and hay, and some for corn and small grains. Part is idle. Lespedeza and volunteer grasses are the chief hay and pasture plants. Idle land has an uneven cover of broomsedge, briers, sassafras, and persimmon. Under common management row crops are grown at frequent intervals for a period of years, after which the soil is left idle for some time. Little fertilization is practiced. Moderate quantities of lime have been applied to some areas. Under common management crops produce low yields and pasture sods are not of high quality or carrying capacity.

Chiefly because of strong slope, poor tilth, and rather unfavorable moisture relations, this soil is not suited to crops. When adequately limed, fertilized, and seeded, it is capable of producing good pasture having a carrying capacity of about 70 cow-acre-days. Areas that must be cultivated should be used in long rotations consisting chiefly of fall-sown small grains and legume-and-grass hay crops. Under good management alfalfa can be expected to yield about 2 tons an acre. Particular care is required to control runoff when tillage is practiced. Field operations should be done on the contour, and methods to divert excess runoff may be practical in places. Some farmers are of the opinion that subsoil furrows 6 to 8 feet apart aid in increasing the ability of the soil to absorb moisture.

Bolton silt loam, eroded steep phase (25+% slopes) (BH).—This phase differs from the eroded hilly phase chiefly in having stronger slopes. The quantity of original surface soil in the plow layer may be a little less than for the eroded hilly phase, and exposures of subsoil may be more common. The plow layer generally is dark-brown mellow loam or silt loam; it grades to a reddish-brown firm but friable silty clay subsoil. Bedrock of cherty dolomitic limestone with sandy lenses, or in places sandy limestone, is at depths of 15 to 30 feet. Some chert and some dark-brown sandstonelike fragments are common throughout the entire soil. The small uncultivated acreage under native forest has a surface soil of dark-brown mellow silt loam or loam to depths of as much as 12 inches.

Internal drainage is moderate. The capacity of the soil to hold moisture available to plants is moderately high. The fertility is medium to high, and the reaction is medium to strongly acid.

Use and management.—Most of this soil has been cleared and cultivated. A great part of it is now used for pasture or is idle, and a small part is used for corn and hay. Pastures consist chiefly of lespedeza and volunteer plants such as broomsedge and crabgrass.

The quality of grazing is low and the carrying capacity is about 55 cow-acre-days. Preparation of a good seedbed, application of lime and phosphorus, proper seeding, and eradication of weeds and brush are the main requirements for establishing productive pasture. A small acreage receives approximately this treatment and has a carrying capacity of about 90 cow-acre-days. Strong slopes make this soil poor for crops, as runoff is difficult to control and field work is carried on with great difficulty.

Bolton silty clay loam, severely eroded steep phase (25+% slopes) (BM).—This soil comprises areas, formerly of steep Bolton silt loam, from which erosion has removed practically all of the surface soil and in places part of the subsoil. It is widely distributed over much of the Fullerton-Bolton-Clarksville soil association, almost entirely on the east- and northeast-facing slopes. The plow layer consists of reddish-brown or yellowish-brown silty clay loam or silty clay. The subsoil is reddish-brown firm but friable silty clay. Sandy cherty dolomitic limestone or limestone with sandy lenses is at depths of 15 to 30 feet. There are some gullies, a few of which may be difficult to cross with machinery. The larger ones are indicated on the soil map by appropriate symbol.

Slopes are steep, and percolation of moisture is impaired somewhat by the firm clayey plow layer. The capacity for holding moisture available to plants is restricted; fertility is medium.

Use and management.—All of this soil has been cleared and cultivated. A large part is now used for pasture; practically all the rest is idle and covered with broomsedge, briers, sassafras, and persimmon. In a few places shortleaf pine is established. Pastures generally are of poor quality and consist chiefly of lespedeza or broomsedge. Fertilization and seeding with clovers and grasses other than lespedeza and redtop are not common. The carrying capacity accordingly is low. Lime has been applied to a small acreage but the steep slope makes seeding and application of lime or fertilizer difficult. Where enough lime and phosphorus have been applied and proper seeding and weed-control practices are followed, nutritious pasture sods with a carrying capacity of about 70 cow-acre-days can be obtained. Building up the soil to this level usually requires several years, as favorable tilth and a good moisture-holding capacity cannot be developed quickly.

Bolton silt loam, eroded rolling phase (5–12% slopes) (BG).—This brown soil occurs on the uplands of the cherty ridges, largely on the east- and northeast-facing parts of the ridge tops. It is widely distributed over the Fullerton-Bolton-Clarksville soil association in tracts 5 to 30 acres in size. It is similar to the eroded hilly phase but has a smoother surface and is confined more to the ridges than to the ridge slopes. In general the surface layer is thicker and patches where erosion has removed all the surface layer are fewer.

Profile description:

0 to 6 inches, dark-brown mellow loam or silt loam that has a fluffy or spongy feel.
6 to 15 inches, yellowish-brown or reddish-brown friable silty clay loam.
15 to 40 inches, reddish-brown firm but notably friable silty clay.
40 inches+, red firm but friable silty clay with faint gray, yellow, and brown mottles; contains some chert fragments.

In places, the subsoil is less red. A great part of this phase has some dark-brown sandstonelike fragments as well as some chert fragments. Small dark-brown concretions are common in the subsoil. The small acreage still under native forest has a surface layer 8 to 12 inches thick. In a few small cultivated areas the subsoil is exposed and a plow layer consists of reddish-brown silty clay.

This soil is medium to strongly acid. It is moderately high in fertility—higher than Fullerton but not quite so high as the Dewey and Decatur soils. It is notably permeable, and runoff does not develop so quickly as on the Dewey, Decatur, Sequoia, and Fullerton soils. Its tilth is similar to that of Bolton silt loam, eroded hilly phase.

Use and management.—Most of this phase has been cleared and cropped. At present, corn, small grains, hay, tobacco, and vegetables occupy the largest part. The rest is in native forest or lies idle. Most of the more eroded parts are idle and have a sparse covering of broomsedge, briers, lespedeza, and sassafras and persimmon sprouts. On cropped areas the most common rotation is corn, a small grain, and then 2 or 3 years of mixed lespedeza and redtop for hay. Much of the cropland has received 2 to 3 tons of lime an acre. Corn and small grains generally receive 75 to 125 pounds of 20-percent phosphate or its equivalent, or 0–10–4 or 2–10–2 fertilizer. A little barnyard manure is used. Vegetables and tobacco receive some barnyard manure in addition to 500 to 1,000 pounds an acre of some high grade fertilizer. Some pastures have been treated with lime and a few with phosphorus fertilizer. Generally the treatment has not been adequate to establish and maintain pasture of high quality. Under the ordinary management described above, corn yields 20 to 30 bushels, wheat about 12 bushels, lespedeza about 0.9 ton, and alfalfa about 2.4 tons.

This moderately productive soil is easily worked and conserved and is suited to a wide variety of crops. It responds well to good management and can support a row crop each third or fourth year. Its chief requirements are fertilization with phosphate and lime, maintenance of organic content, use of legumes for a great part of the rotation, and the use of close-growing crops, including winter cover crops, to restrain erosion caused by runoff. Much of the soil can well be tilled on the contour, and on parts of it strip cropping can be used to advantage. Where this soil is kept relatively fertile, it is capable of producing 50 bushels of corn, 3 tons of alfalfa, or 1,700 pounds of tobacco an acre. As on many other soils of the county, alfalfa may require applications of boron at regular intervals. Although native or volunteer pasture is ordinarily not of high quality, pastures of excellent quality can be maintained where adequate fertilization, proper seeding, and elimination of weeds and brush are practiced.

Bolton silty clay loam, severely eroded rolling phase (5–12% slopes) (Bl).—This soil occupies areas formerly covered by the rolling Bolton silt loam from which erosion has removed most of the surface soil and in places part of the subsoil. The separate areas are of limited size and are widely distributed over much of the Fullerton-Bolton-Clarksville soil association. The plow layer is reddish-brown firm but friable silty clay loam or silty clay. The subsoil is predominantly reddish-brown firm but friable silty clay. Bedrock of sandy

cherty limestone or limestone with sandy lenses is at depths of 15 to 30 feet.

Internal drainage, though adequate for most crops, is notably retarded by the firm clayey plow layer and subsoil; consequently, runoff develops rapidly.

Use and management.—All of this soil has been cleared and cropped but a large part is now idle. The cropped acreage is used chiefly for corn, hay, and pasture; a small part is used for tobacco. Lespedeza is the main hay crop. Much of the pasture consists of lespedeza, broomsedge, and some redtop. Little fertilization is practiced, and on some areas row crops are grown at frequent intervals. It is a common practice to use this soil for crops several years and then allow it to lie fallow for a period. While it is idle, an uneven cover of broomsedge, briers, sassafras, and persimmon develops. Under average conditions corn yields about 13 bushels and lespedeza about 0.4 ton an acre.

This soil is considered suitable for crops; its usefulness is limited chiefly by the compact clayey surface layer. Poor tilth makes it difficult to work, and its clayey nature limits its capacity to hold moisture available for plants. The soil responds to good management, but ordinarily several years are required to bring it to relatively high productivity. Its chief requirements are lime, phosphorus, and organic matter. Long rotations consisting chiefly of close-growing crops, mostly legumes, are well suited. The moderately strong slopes, together with slow permeability, make control of runoff particularly important. Luxuriant close-growing crops such as alfalfa, orchard grass, bluegrass, and white clover are well suited. After several years of adequate fertilization and other good management, 25 bushels of oats or 2 tons of alfalfa an acre can be produced. Under good management the carrying capacity of mixed legume-and-grass pasture is about 75 cow-acre-days.

Camp silt loam (2–5% slopes) (CA).—This dusky-red soil occurs on the gentle foot slopes and along drainageways at the base of the hilly upland areas of Bland soils. It consists of local alluvium washed from those soils. Much of it occurs in narrow strips along the upper reaches of drains and some on sloping alluvial fans. All areas are associated with Bland soils in the Bland-Camp soil association. The surface is gently sloping to sloping; the extreme slope range, however, is 2 to 20 percent. Internal drainage is medium.

Profile description:

0 to 10 inches, weak-red to dusky-red silt loam.
10 to 50 inches+, dusky-red silty clay loam grading to a lighter shade and more clayey texture with depth; limestone or shale bedrock at depths of 2 to 15 feet.

In places the texture of the surface soil is silty clay loam. Close to the drainage channels the subsoil may be mottled and the internal drainage imperfect.

This soil is medium in fertility. It is not very acid and has medium organic content and moderately slow permeability. The capacity to hold moisture for plants is fairly high, and moisture relations generally are favorable for the crops commonly grown.

Use and management.—A great part of this soil has been cleared and is used for crops, chief of which are corn, tobacco, vegetables, hay,

and grain. Some fertilizer and lime are used but not much barnyard manure. Cover crops are not commonly plowed under. Corn and small grains sometimes receive 100 to 125 pounds of 20-percent phosphate or its equivalent; tobacco and vegetables are regularly fertilized with 500 to 800 pounds an acre of 3–9–5, 2–10–2, or 4–12–4. Under average management corn yields 30 bushels and lespedeza 1.2 tons an acre.

This Second-class soil is well suited to a wide variety of crops. It is moderately productive, has very good workability, and is not difficult to conserve. Much of it occurs where the acreage of soils well suited to crops is small. As a result, it is commonly in demand for crops that require tillage.

Where fertility is maintained, this soil is capable of supporting a 3-year rotation. Phosphorus and organic matter are among the chief requirements, and though most of the acreage is not very acid, lime may be needed in places. The finer textured or more clayey parts require some care in tillage; they may become cloddy if worked when wet. Under good management good yields of practically all crops can be maintained and legume-grass pastures are easily established.

Chewacla silt loam (0–2% slopes) (Cb).—This imperfectly drained soil occurs on first bottoms along the French Broad River. It consists of young general alluvium, a great part of which was washed from soils in mountain regions to the east that are underlain by slate, gneiss, schist, and granite. Like the Congaree soils, the Chewacla is distinguished from other first bottom soils of Knox County by the abundance of mica flakes. The separate areas are associated with Congaree soils and generally lie in slightly lower positions. All areas are subject to flooding, although this hazard is less since the construction of Douglas Dam in the French Broad River upstream from Knox County. Internal drainage is slow.

Profile description:

0 to 12 inches, brown or light-brown loam or silt loam.
12 to 24 inches, light-brown silt loam with some yellow and gray mottlings.
24 inches+, mottled-gray, yellow and brown friable silt loam.

The natural fertility is high but the reaction is medium to strongly acid. Although the soil is permeable, the water table is high enough to cause excess ground water to move slowly from the soil.

Use and management.—Practically all of this soil has been cleared of its original deciduous forest. Corn occupies about half the acreage, and hay and pasture most of the rest. Lespedeza, redtop, timothy, and other grasses are the chief hay and pasture plants, although bluegrass and white clover are common to some of the permanent pastures. The cultivated acreage is used in short rotations and little fertilization is practiced. Under average conditions corn yields 35 to 40 bushels and lespedeza 1.2 to 1.5 tons an acre. The carrying capacity of pasture is about 90 cow-acre-days.

This is a Second-class soil. It is productive and suited to intensive use when adequately fertilized, but its slow drainage interferes with field work and limits its suitability. Its susceptibility to flooding is a hazard to crops and grazing. Except during periods of high water, moisture conditions are particularly favorable for pasture and such late-season crops as corn, lespedeza, redtop, orchard grass, timothy, and soybeans. The very occasional inundation during the growing

season is a real hazard. The flooding and resulting deposit of mud ruins crops or pasture or greatly decreases the yield. Winter and early spring floods are a hazard only to fall-sown crops. The spring floods, however, may postpone planting to a late date. Alfalfa, potatoes, tobacco, and fall-sown crops are not suited, mainly because of the wetness of the subsoil and the hazard of overflow.

Management for the best suited crops is not exacting. The soil will respond to fertilization, especially with phosphorus and lime, but fairly high yields are obtained with little or no fertilization. Artificial drainage may widen the suitability to crops and raise the general productivity for some areas. The feasibility of drainage depends on the initial cost, the improvement that can be expected, and the need for a wider range of suitability on the farm. The chief requirements for obtaining pastures of high quality are liming and eradication of weeds. Under these practices bluegrass and white clover commonly develop a luxuriant growth with a carrying capacity of about 125 cow-acre-days. Where good management is practiced, 60 bushels of corn and 1.9 tons of lespedeza are average yields an acre.

Clarksville cherty silt loam, rolling phase (5–12% slopes) (CG).—This gray very cherty soil, known locally as white gravelly land, is common on the rolling tops or crests of the cherty ridges. It is widely distributed throughout most parts of the Fullerton-Bolton-Clarksville soil association. The separate areas cover 15 to 70 acres and are almost invariably flanked by hilly or steep Clarksville or Fullerton soils on the ridge slopes. This, as well as the other Clarksville soils, differs from the associated Fullerton soils in having a yellowish rather than reddish subsoil and a higher content of chert. It has developed from cherty dolomitic limestone. Internal drainage is medium.

Profile description:

0 to 8 inches, gray cherty silt loam.
8 to 20 inches, grayish-yellow cherty silt loam.
20 to 50 inches, brownish-yellow or yellow firm but somewhat friable cherty silty clay.
50 inches+, variegated (reticulated) reddish-yellow, yellow, and gray firm cherty silty clay; cherty dolomitic limestone bedrock is at depths of 20 to 40 feet.

A considerable acreage is so cherty that tillage is extremely difficult or impossible. Most of these areas are indicated on the soil map by appropriate symbol.

The natural fertility and organic-matter content are very low, and the reaction is uniformly strongly acid. Permeability to roots and moisture and ability to hold moisture for plants are fairly good.

Use and management.—A very great part of the rolling phase is under natural deciduous forest consisting chiefly of oaks. The small acreage cleared is used for corn, lespedeza and redtop, tobacco, and vegetables. The little fertilization practiced consists mainly of relatively heavy applications for tobacco. Yields of crops under average conditions are small, and pasture is of poor quality and low carrying capacity.

Chiefly because of its low fertility and chertiness, this is considered a Third-class soil. It is suited to a fairly wide range of crops, but high crop yields and good stands of either alfalfa or legume-grass pasture are difficult to maintain. Large applications of fertilizer, organic matter, and lime are required if good yields are to be main-

tained. Corn, small grains, lespedeza, redtop, orchard grass, some vegetables, and tobacco are among the better suited crops. The permeability of this soil makes it particularly favorable for many fruits and some early truck crops such as potatoes and cabbage. Runoff is not difficult to control, though the more sloping parts require some protection when the soil is cultivated. Under good management corn yields about 40 bushels, wheat 17 bushels, lespedeza 1.4 tons an acre, and pasture 65 cow-acre-days of grazing.

Clarksville cherty silt loam, eroded rolling phase (5–12% slopes) (CD).—This soil is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. It is one of the common soils on the ridge tops in this association. The separate tracts, 15 to 70 acres in size, are flanked by hilly or steep Clarksville or Fullerton soils on the ridge slopes. This phase differs from the rolling phase chiefly because it has lost soil material through erosion. The subsoil now is within plow depth on more than half the acreage. Ordinary tillage mixes the subsoil with the remaining part of the original surface layer to form a plow layer of yellowish-gray cherty silt loam. The brownish-yellow silty clay subsoil generally lies directly below the plow layer but is at the surface on the more exposed knobs. Cherty dolomitic limestone bedrock is at depths of 20 to 40 feet. The more cherty areas are represented on the map by appropriate symbol.

Internal drainage is moderate. Natural fertility and organic-matter content are low, and the reaction is strongly acid. The soil is permeable to both roots and moisture and its capacity to hold moisture for plants is fairly good.

Use and management.—All of this soil has been cleared and used for crops. About half of it now is cropped, some is idle or reverting to forest, and the rest is in permanent pasture. The idle soil has a variable cover of broomsedge, briers, sassafras, and persimmon; the better reforested areas have a cover of pine. Permanent pastures consist mostly of broomsedge and lespedeza and are not of high quality or of a very high carrying capacity. Lime has been applied to a few areas at the rate of 1 to 2½ tons an acre. Moderately heavy applications of mixed fertilizer and manure are used for tobacco. Corn, wheat, and lespedeza-and-redtop hay are the other commonly grown crops; they do not receive much fertilizer and produce low yields.

The chief management requirements are addition of fertilizer, organic matter, and lime, although some runoff control is necessary. Well suited, at least to the more sloping parts, are moderately long rotations (4 to 5 years) that include fall-sown cover crops and close-growing small grains and hay and pasture crops. Corn, small grains, lespedeza, redtop, orchard grass, tobacco, berries, peaches, and vegetables are among the more productive crops when good management is practiced. Legume-grass pastures of high quality are more difficult to maintain on this soil than on those of higher natural fertility. Nevertheless, if fertility is improved and well maintained, lime is applied, seeding is properly done, and weeds and brush are eradicated, a grazing capacity of about 65 cow-acre-days can be maintained.

Clarksville cherty silt loam, hilly phase (12–25% slopes) (CF).—This is a very cherty soil of the cherty ridges. It is widely distributed over the Fullerton-Bolton-Clarksville soil association. The separate areas are mainly on ridge slopes, although a few extend to

the tops or crests of ridges. Some occupy as much as 20 acres. The soil is similar to the rolling phase; it differs chiefly in having a stronger slope.

The surface soil, approximately 8 inches thick, is gray cherty silt loam; below this and extending to a depth of about 20 inches is grayish-yellow cherty silt loam. The subsoil is brownish-yellow or yellow firm cherty silty clay. Below a depth of 50 inches is variegated (reticulated) reddish-yellow, yellow, and gray firm cherty silty clay.

The soil has developed over cherty dolomitic limestone, which is at depths of 20 to 40 feet. Many areas are so cherty that tillage is extremely difficult or impossible. Most of these cherty areas are indicated on the soil map by appropriate symbol.

This soil is very low in fertility and strongly acid. It is permeable, to both water and plant roots. Internal drainage is medium. The organic-matter content is very low, but the moisture-holding capacity is fairly good.

Use and management.—Practically all of this soil is under native deciduous forest. The stand consists chiefly of oaks, though some hickory and other hardwoods and a few pines are intermixed. The small part cleared is used chiefly for corn, hay, and pasture. Crop yields are normally low because fertility is rather low and the level of management practiced is generally low. Lespedeza, broomsedge, and redtop are predominant in meadows and pastures. Under ordinary management, which includes little fertilization or liming, yields will be low. Corn will produce about 12 bushels an acre, and lespedeza about 0.4 ton. The carrying capacity of common pasture is about 27 cow-acre-days.

Chiefly because of its low natural fertility, chertiness, and hilliness, this soil is not considered suitable for crops. If properly seeded and adequately fertilized, especially with lime and phosphorus, fairly good pasture with a carrying capacity of about 60 cow-acre-days can be maintained. If this soil is required for crops, relatively high productivity can be maintained by using a long rotation (6 to 7 years), applying fertilizer, especially phosphorus and lime, in large quantities, and adding organic matter. The strong slope necessitates some special attention to runoff control. The long rotation should consist largely of close-growing small grains, hay, pasture, and winter cover crops, and even with this rotation, supplementary measures such as contour tillage and possibly strip cropping will be needed. In places, it may be expedient to divert runoff by ditches or other mechanical means. It seems unlikely, however, that a regular system of terraces is practical on the slopes characteristic of this soil.

Clarksville cherty silt loam, eroded hilly phase (12–25% slopes) (Cc).—This soil, one of the more extensive members of the Clarksville series, is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. The separate areas are rather large and for the most part occupy the cherty ridge slopes.

This phase differs from the hilly phase chiefly in having lost much soil material through erosion. The subsoil is now within plow depth on more than half the acreage, so that ordinary tillage mixes it with the remaining part of the original surface layer.

The plow layer is yellowish-gray cherty silt loam. The brownish-yellow firm silty clay subsoil is generally directly below it. In some

places erosion has removed all of the original surface layer and the plow layer therefore consists of brownish-yellow silty clay subsoil material. There are a few gullies, most of which can be crossed with farm machinery. The larger gullies are indicated on the soil map by appropriate symbol.

Like the hilly phase, this soil is strongly acid and low in fertility and organic matter. It is permeable to both roots and moisture, however, and has fairly good capacity for holding moisture available to plants. Some places have a considerable amount of chert; these are indicated on the soil map by symbol.

Use and management.—All of this soil has been cleared and cropped. At present about 50 percent is used for pasture and 10 percent for crops. About 25 percent is idle, and the rest is under reestablished pine forest. The main crops are corn, small grains, lespedeza, redtop hay, and some vegetables and tobacco. Little fertilization is practiced and no systematic rotation is followed. Lime has been applied to some areas. Some of the row crops, chiefly tobacco, have received fertilizer. Little organic matter has been returned to the soil. Crop yields under this level of management are low; corn yields about 12 bushels an acre, and lespedeza about 0.4 ton. Pasture consists mainly of broomsedge and lespedeza and has an average carrying capacity of about 25 cow-acre-days. Land left idle has a variable cover of broomsedge, briers, sassafras, and persimmon. It is a common practice to leave the soil idle for several years, then cultivate it for a few years, and again leave it idle for another period.

Chiefly because of its hilliness, chertiness, and low fertility, this soil is not considered well suited to crops. It is capable of supporting fairly good pasture if adequately fertilized and limed and properly seeded to such pasture plants as clovers and orchard grass. Bluegrass and white clover might make satisfactory pasture, but these plants and alfalfa may require soils of greater fertility. Under a high level of management, pasture will ordinarily produce 60 cow-acre-days of grazing.

Clarksville cherty silt loam, steep phase (25+% slopes) (CH).—This steep very cherty gray soil of the cherty ridge sections occurs in the Fullerton-Bolton-Clarksville soil association. It is one of the most extensive of the Clarksville soils. The separate areas are large. Some of them occupy 250 to 350 acres and consist of relatively long slopes along drains that extend into the rougher parts of the soil association.

The profile is similar to that of the hilly phase, but the soil material contains more chert, the depth to bedrock is less, and outcrops of chert and limestone are more common. The parent rock, cherty dolomitic limestone, is normally at depths of 10 to 30 feet, but occasionally there are outcrops of chert or limestone on the steepest parts. The soil is strongly acid and low in fertility and organic matter; it is permeable to both moisture and plant roots.

Use and management.—Practically all of this soil is under deciduous forest. The stand consists chiefly of oaks, though hickory, dogwood, redbud, and some pine are intermixed. Chiefly because of its strong slope, low fertility, and high content of chert, it is poorly suited to either crops or pasture.

Clarksville cherty silt loam, eroded steep phase (25+% slopes) (CE).—This soil occurs in steep areas, formerly occupied by the un-

eroded steep phase, that have lost a considerable part of the original surface soil through erosion. Much of it is in the steeper parts of the Fullerton-Bolton-Clarksville soil association. The separate areas are relatively large and many of them have rather long slopes.

The surface layer to plow depth is yellowish-gray or yellow cherty silt loam or cherty silty clay loam, the more eroded parts consisting almost wholly of subsoil material. In some places erosion has removed all of the more silty material and the plow layer therefore consists of brownish-yellow firm cherty or very cherty silty clay. There are a few chert or limestone outcrops, most of which are indicated on the soil map by appropriate symbol.

Like the other Clarksville soils, this soil is strongly acid and low in fertility and organic matter. It is more slowly permeable than the less eroded Clarksville soils, and consequently runoff develops more quickly during rains. Gullies are common but most of them can be crossed with farm machinery. The larger gullies are indicated on the map by appropriate symbol.

Use and management.—All of this soil has been cleared and cropped, but a great part is now idle and grown over with broomsedge, briers, sassafras, and persimmon. Some areas are used for pasture; they have a cover consisting mainly of broomsedge and lespedeza, with smaller amounts of briers and brush. Chiefly because of very strong slope, chertiness, and low fertility, this soil is poorly suited to either crops or pasture. Areas needed for pasture will respond to seeding with suitable grasses and legumes and to fertilization, especially with phosphorus and lime. Under good management pastures have a carrying capacity of about 50 cow-acre-days.

Colbert silty clay loam, eroded undulating phase (2–5% slopes) (CN).—This soil occurs chiefly in rolling valleys underlain by argillaceous limestone and is associated with the Talbott soils in the Stony land-Talbott soil association. It is characterized by its yellowish fine-textured plastic subsoil and its shallow depth to bedrock. A considerable part of the original silt loam surface soil has been removed by erosion; consequently, the subsoil is exposed in places and the plow layer consists partly of subsoil material. This soil differs from the Talbott soils in having a very heavy plastic yellow subsoil. Surface drainage is adequate, but internal drainage is slow.

Profile description:

0 to 6 inches, brownish-gray friable silty clay loam.
6 to 10 inches, grayish-yellow moderately plastic silty clay loam.
10 to 30 inches, olive-yellow very firm plastic clay with some reddish and gray mottles; clayey (argillaceous) limestone bedrock at depths of 2 to 3 feet.

Small dark or nearly black concretions are common in the upper subsoil. Where erosion has been more active, the plow layer is more clayey and plastic, or almost identical to the subsoil in the less eroded areas. There are a few bedrock outcrops but not enough to make tillage impractical.

This soil is medium to strongly acid, moderately fertile, and rather low in organic matter. Because it is clayey, the soil has limited capacity to hold water for plants. Plants suffer for lack of moisture early during droughts.

Use and management.—About 75 percent of this soil has been cleared and is used for either crops or pasture; the rest is under deciduous

forest consisting chiefly of oaks. About half of the cleared land is used for hay and pasture, 40 percent for small grains, and the rest for row crops, chiefly corn and tobacco. Lespedeza is the main hay crop. Pasture consists chiefly of lespedeza, redtop, crabgrass, and broomsedge. Commonly used are 3- to 5-year rotations consisting of corn, a small grain, and then lespedeza for hay or pasture. Lime has been applied to much of the soil at the rate of 2 tons an acre. Light applications of phosphate fertilizer—75 to 125 pounds of 20-percent phosphate or its equivalent—are commonly used for small grains. Other fertilization or the application of organic matter is not common. Lime has been applied to some pastures. Under common management yields are rather low. Corn produces about 18 bushels an acre, wheat 12 bushels, and lespedeza 0.7 ton. Heavier applications of fertilizer are used where tobacco is grown.

Although this soil is suitable for crops, its use is limited by its firm plastic subsoil and shallow depth to bedrock. Chiefly because of these characteristics, productivity is not high and tillage and conservation present some difficulties. Tilth easily deteriorates when the soil is wet, and erosion is active on the more sloping parts during cultivation.

The soil is not well suited to tobacco or to root crops such as potatoes. For general farming, small grains and hay and pasture crops are more productive. If this soil is properly fertilized and limed and its organic-matter content is improved, it is well suited to legumes and grasses, including alfalfa, red clover, white clover, timothy, orchard grass, and bluegrass. Moderately long rotations should be used. The more sloping parts should be kept under close-growing vegetation as long as possible, since runoff water accumulates quickly during rains. Loss of soil material through runoff is particularly detrimental to soils shallow to bedrock.

Lime, phosphorus, and organic matter are the chief fertilizers required. If fertilization is adequate and good tilth is maintained, oats yield about 35 bushels, alfalfa 2.9 tons, and lespedeza 1.3 tons an acre. Alfalfa will likely require applications of boron. Where adequately fertilized, pastures of white clover and bluegrass or Bermuda grass are of good quality and have a carrying capacity of about 90 cow-acre-days. Pasture soon deteriorates during dry periods, since the soil holds limited moisture for plants.

Colbert silty clay loam, eroded rolling phase (5–12% slopes) (Cm).—This soil is distinguished from the eroded undulating phase by stronger slopes. It is associated with other Colbert soils, Talbott soils, and Stony land types that consist of limestone material. The separate areas are small and widely distributed in the Stony land-Talbott association. The soil has developed over argillaceous (clayey) limestone. Internal drainage is slow. The profile is similar to that of the eroded undulating phase except that severely eroded patches exposing yellow plastic clay subsoil are more common. There are more rock outcrops, but not enough to prohibit tillage. The soil is low in fertility and organic matter. It is medium to strongly acid except where free lime carried by runoff water from bedrock outcrops affects the surface soil.

Use and management.—A great part of this soil is used for small grains, hay, and pasture. Lespedeza, redtop, timothy, and orchard

grass are the more common hay and pasture plants. Some small areas are in row crops, chiefly corn; others are under native forest consisting largely of oaks. Crops are not regularly rotated but their sequence approximates a rotation of corn, a small grain, and 2 or 3 years of hay or pasture. A small quantity of mixed fertilizer approximating 0–10–4 or 2–10–2 or a small amount of 20 percent phosphate is commonly used for corn and small grains. Turning under of cover crops or other means of adding organic matter are not commonly practiced. Under this management, corn yields about 15 bushels, and lespedeza 0.6 ton. When alfalfa is being established, it receives relatively heavy fertilization. The applications usually range from 200 to 500 pounds of high-grade fertilizer and from 2 to 4 tons of lime an acre. With such fertilization, alfalfa yields about 2.2 tons an acre.

This soil is not particularly well suited to crops, chiefly because it is compact and plastic, shallow to bedrock, and moderately strongly sloping. If careful management is practiced, however, fairly good yields of better suited crops such as small grains, legume-and-grass hay, and pasture can be produced. The high susceptibility to erosion requires that fairly high fertility be established and that long rotations consisting chiefly of close-growing small grains, hay, and pasture be used. Alfalfa, red clover, white clover, timothy, bluegrass, and Bermuda grass are well suited and are easily maintained if a high fertility is established and the organic-matter content is raised to at least a moderate level. As for the eroded undulating phase, pasture on this soil deteriorates early during droughts. During rainy periods, especially in spring and early in summer, pastures will supply about 80 cow-acre-days of grazing.

Colbert silty clay, severely eroded rolling phase (5–12% slopes) (CL).—This phase occurs in relatively small tracts widely distributed over the Stony land-Talbott soil association. It occupies rolling areas, formerly occupied by uneroded Colbert soil, that have been severely eroded. Practically all of the original surface soil and in places part of the subsoil have been lost. The plastic clay subsoil is exposed. The plow layer consists of olive-yellow plastic silty clay. The underlying subsoil grades to olive-yellow plastic clay mottled with gray. Clayey limestone bedrock is at shallow depths, in most places at less than 2 feet, and there are occasional rock outcrops.

Internal drainage is slow and runoff water accumulates quickly. The soil is strongly acid, low in fertility and organic matter, and very low in capacity for holding moisture for plants.

Use and management.—All of this soil has been cleared and cropped but a very large part is now idle or in unimproved pasture or meadow. The idle land has a sparse covering of broomsedge, weeds, and briers. Little corn or small grain is grown. Lespedeza, redtop, and orchard grass are the chief hay crops. Crop yields and the carrying capacity of pasture are very low. The soil is poorly suited to crops, chiefly because it is plastic and clayey, shallow to bedrock, unfavorable in slope, and poor in moisture relations. Even under a high level of management, it holds limited moisture for plants and produces little pasture. Proper fertilization, liming, seeding, and eradication of weeds can bring the carrying capacity of pastures to about 55 cow-acre-days.

Colbert silty clay, severely eroded hilly phase (12–25% slopes) (CK).—This soil covers all the hilly Colbert areas that are severely eroded. The separate areas are widely distributed throughout the Stony land-Talbott soil association. Many are closely associated with stony land types and Limestone rockland. Like the other Colbert soils, this one developed from high-clay limestone.

Practically all of the acreage has been cleared and cropped. The resulting erosion has removed almost all of the original surface soil and in places part of the subsoil. The plow layer in most places consists of a grayish-yellow firm moderately plastic silty clay. Limestone bedrock is at depths of about 18 inches. Outcrops are common. In some places these outcrops are hard limestone, and in others soft or shaly limestone. The small acreage not severely eroded has a thin surface layer of grayish-yellow silt loam or silty clay loam over plastic yellow clay.

The natural fertility and content of organic matter are very low. Also, the capacity of this soil to hold moisture for crops is very limited. The reaction varies from medium to strongly acid, except where tillage has mixed parts of underlying bedrock with the soil material or where runoff water carries limy material to the soil from bedrock outcrops. Permeability and tilth conditions do not favor plant growth.

Use and management.—Although practically all of this soil has been cleared, little is now used for crops. A small area is used for hay or pasture. The greater part is idle and covered largely by weeds, briers, a variable amount of lespedeza, and sassafras and persimmon sprouts. On the small cropped acreage, corn, small grains, and lespedeza predominate. Crop yields are very low, and pastures are of inferior quality and low in carrying capacity.

This soil is poorly suited to crops, chiefly because of its low fertility, shallow depth to bedrock, strong slope, and unfavorable tilth and moisture relations. It is capable of affording fairly good grazing. When properly fertilized and otherwise rejuvenated, it supports a moderately good cover of the more desirable pasture plants such as bluegrass, white clover, Bermuda grass, and orchard grass. Its unfavorable moisture relations make it particularly droughty. Pasture becomes dry early during dry weather. Where this soil has been handled under a high level of management for a number of years, the carrying capacity is about 45 cow-acre-days.

Congaree fine sandy loam (0–3% slopes) (Co).—Like other Congaree soils, this is a brown well-drained soil on first bottoms. It consists of general alluvium, a great part of which came from micaceous rocks. The parent material for the Congaree soils in Knox County has been transported by French Broad River from areas to the east in which slate, granite, gneiss, and schist make up a great part of the rocks.

This soil occupies some of the higher parts of the first bottoms along the French Broad River, mostly as elongated strips parallel to the river channel. A few areas are adjacent to the channel but many others are separated from it by narrow strips of low-bottom phases of Congaree soils.

This soil is nearly level or very gently undulating, and most of it is 15 to 30 feet above the surface of the river. Normally it is subject

One of the smoother more fertile sections in Knox County well suited to general farming in which livestock is an important source of income.

A, Spring grazing on an excellent crop of crimson clover on the Decatur-Dewey-Emory soil association; later the crop will be turned under as a green manure. *B*, Corn, small grain, and hay on the Decatur-Dewey-Emory soil association. These crops occupy much of the acreage in this association and yield well.

A, Small grain on the productive but inextensive Cumberland silty clay loam, eroded undulating phase.

B, An area of Dandridge shaly silt loam, eroded steep phase, cultivated for many years and so eroded that bedrock shale now outcrops.

A, Foreground, Dandridge and Litz shaly silt loams, eroded hilly phases.
B, Dandridge and Litz shaly silt loams, eroded steep phases.

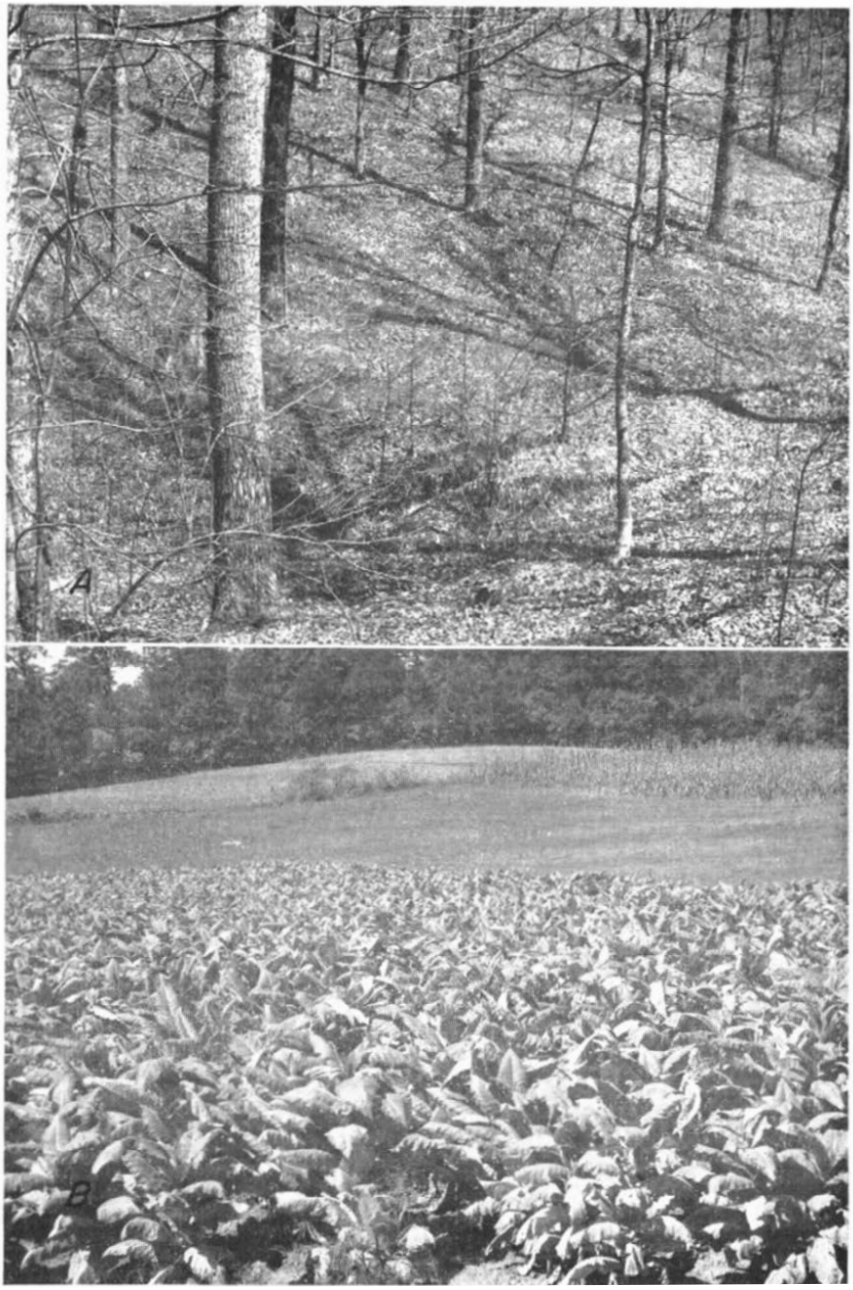
A, Fall-sown small grain on Dewey silty clay loam, eroded undulating phase. Clovers and grasses are commonly seeded with the small grain to furnish grazing or a hay crop later.

B, Legume-and-grass pasture on Dewey silty clay loam, eroded hilly phase, and corn on Dewey silty clay loam, eroded undulating phase.

A, View of smooth Farragut soils. Like soils of the Decatur series, the Farragut soils are fertile and not difficult to manage.

B, Road cut through Fullerton soil, showing the moderate amount of chert throughout.

A, A good crop of hybrid corn on Fullerton silt loam, undulating phase.
B, Idle or abandoned area of Fullerton cherty silt loam, eroded hilly phase, that was depleted of its limited natural fertility and much of its surface soil by years of intensive cropping.



A, Cut-over deciduous forest on steep Fullerton soil.
B, Tobacco on Greendale silt loam, undulating phase. The adjacent more rolling soils in the background are Fullerton soils.

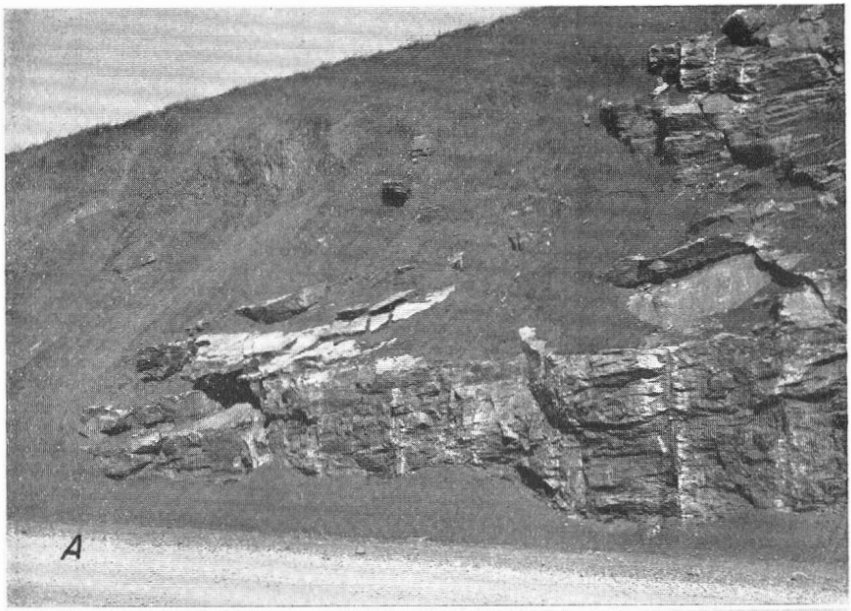
A, The light-colored gentle slope is Leadvale soil, which consists of alluvium washed from an area of soils developed from shale; the dark area on the left is Emory soil, which consists of alluvium washed from soils developed over high grade limestone. Both are well suited to crops, but the fertility of the Emory is higher and more easily maintained.

B, Lindside silt loam along a creek in a hilly landscape. In these sections such fertile and easily worked and conserved soils make up a small proportion of the farm and are commonly used continuously for row crops, chiefly corn.

A road cut through an area of Montevallo soil showing the very shallow depth to the finely fissile acid shale bedrock.

A, Native forest on Sequoia soils consists of hardwoods, chiefly oaks, with some shortleaf pine intermixed.

B, Eroded undulating and eroded rolling phases of Sequoia silty clay loam in foreground. Broader areas such as this are most common in the Sequoia-Leadvale soil association.

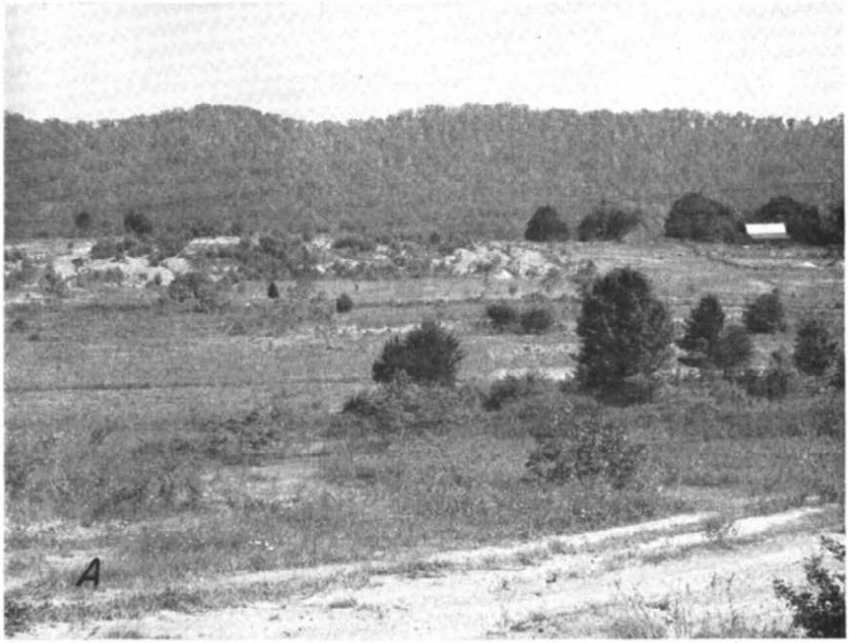


A, Tellico soil over bedrock, much of which is hard calcareous sandstone. The residuum is dusky-red permeable sandy clay loam or sandy clay.

B, Hilly and steep Tellico soils on ridge slopes that have been cleared and used for crops and pasture in places. Much of this acreage is not suited to cultivation and has been severely damaged by erosion.

A, A view of the less hilly part of the Fullerton-Bolton-Clarksville soil association. Here the surface ranges from undulating to hilly and Fullerton soils predominate.

B, A view of Stony land-Talbott soil association, showing the undulating to rolling surface and one of the sinkholes common to this association.



A, A view across Hinds Valley to Beaver Ridge. The Jefferson-Montevallo soil association occupies the valley, and the Muskingum-Lehew association occupies Beaver Ridge.

B, Carefully managed parts of the Jefferson-Montevallo soil association, where more adequate fertilization is practiced and rotations consist predominantly of legume-and-grass hay and pasture and other close-growing crops.

A, Productive narrow strips of Leadvale, Whitesburg, and Hamblen soils along the drains and creeks in the Sequoia-Litz-Dandridge soil association. In such landscapes these alluvial soils can be fertilized heavily and used intensively for crops so that the associated hilly and steep Dandridge and Litz soils can be used only for permanent pasture or forest.

B, Farm in the Sequoia-Leadvale soil association.

A, An area of the Sequoia-Bland soil association, mostly rolling and shallow to shale bedrock; mainly shallow stony steep Muskingum soils on House Mountain in background.

B, Severely eroded abandoned land in a section of the Sequoia-Bland association.

to overflow. This hazard has been diminished since the Douglas Reservoir was built on the French Broad River, upstream from the bottom lands in this county.

Profile description:

0 to 15 inches, brown or grayish-brown fine sandy loam.
15 to 45 inches, brown to light-brown very friable fine sandy loam or fine sandy clay loam.
45 to 70 inches, yellowish-brown to brownish-yellow friable fine sandy loam with slight mottlings of gray.

Mica flakes are abundant through the entire soil. The deep subsoil is variable in texture but generally is coarser than the upper 45 inches. Bedrock is at depths of 10 to 40 feet. A few areas have enough cobblestones to interfere somewhat with tillage. Most of these areas are indicated on the soil map by appropriate symbol.

The soil is relatively fertile, medium to strongly acid, and moderate in content of organic matter. The entire soil is easily permeable to roots and moisture and very favorable for plant growth, as there is generally an abundance of moisture in the deep subsoil.

Use and management.—All of this soil has been cleared and practically all of it is used for crops or pasture. Corn, hay, and vegetables predominate. On many areas corn is grown every year or two. In some places a 3-year rotation of corn, a small grain, and hay is grown, the hay crop consisting of either lespedeza or red clover and timothy. Some fertilization is practiced. The average application for corn and small grains is 125 to 200 pounds of 20-percent phosphate or 0–10–4 an acre. Lime is used on areas where lespedeza or red clover are grown. Vegetables commonly receive 200 pounds of 4–10–4 or 4–12–4 and 6 to 10 tons of manure, and in most places the soil has been treated with lime. Under average conditions corn yields about 40 bushels; lespedeza, 1.3 tons; and pasture, 80 cow-acre-days of grazing.

This is one of the most desirable soils for crops, especially row crops. It is moderately fertile, is easily worked and conserved, and responds well to heavy fertilization. Its productivity can be maintained under a short rotation. Corn, tobacco, and many vegetables are particularly well suited. Small grains will produce well. Where the soil has been adequately lime and its fertility has been kept at a high level, more exacting hay and pasture crops such as red clover and alfalfa will produce high yields. Floodwater has been a hazard to fall-sown crops and alfalfa, but the likelihood of damage is now small. Where fertility is kept high and adequate lime is applied, corn will yield about 60 bushels, alfalfa 3.6 tons, and tobacco 1,800 pounds.

Congaree fine sandy loam, low-bottom phase (0–3% slopes) (Cp).—This phase is distinguished from Congaree fine sandy loam chiefly by its lower position and consequent greater susceptibility to flooding. It occupies very narrow strips adjacent to the channel of the French Broad River. In most places it adjoins higher lying Congaree soils. In some places the surface soil and upper subsoil of this phase are darker brown than those of Congaree fine sandy loam, and in others the profile is coarser textured and lighter colored. The surface is nearly level, and most areas are less than 15 feet above the river channel. Internal drainage is medium to rapid.

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Use and management.—All of this soil has been cleared and practically all of it is cropped. Corn is by far the predominant crop; hay is second in importance. Little fertilization is practiced but under average conditions yields are moderately high. Corn yields about 42 bushels an acre.

This is one of the most desirable soils for crops. It is high in natural fertility and its smooth surface and permeable profile make it very easy to work and to conserve. Nevertheless, its range of suitability for crops is limited by flooding. Winter and spring floods may damage fall-sown crops and alfalfa, and midsummer flooding may be disastrous to high-value crops such as tobacco and vegetables. Favorable moisture relations and permeability make this soil responsive to heavy fertilization. Where high fertility is maintained, corn should yield more than 62 bushels an acre, and lespedeza 1.9 tons. The carrying capacity of pasture can be kept high, although sandy soils such as this generally are not so suitable for the more desirable pasture legumes and grasses as finer textured soils, such as Congaree silt loam and Huntington silt loam.

Congaree silt loam (0–2% slopes) (Cr).—This is a brown well-drained soil on first bottoms along the French Broad River. The separate areas occupy irregular strips parallel to the river channel and lie 15 to 30 feet above the surface of the river. A few strips are moderately broad. Like Congaree fine sandy loam, this soil consists of general alluvium that originally came from micaceous rocks, such as slate, granite, gneiss, and schist, in the Blue Ridge physiographic province to the east. The surface is nearly level to very gently undulating.

Profile description:

0 to 30 inches, brown or dark grayish-brown loam or silt loam.
30 to 36 inches+, brown friable loam or silt loam that may have some faint mottling in the lower part.

Mica is abundant throughout the soil. The texture of the lower subsoil is especially variable. In some places it is moderately sandy and in others it may be finer textured than a silt loam.

This soil is fertile but most of it is medium to strongly acid. The content of organic matter is medium to moderately high. The soil has high capacity for holding moisture available to plants. The water table is at a depth of several feet through most of the growing season. The soil is permeable to both roots and moisture.

Use and management.—Practically all of this soil has been cleared and is now used for crops. Corn predominates but small grains and hay crops, especially lespedeza and red clover, are also grown. Some vegetables are produced for commercial canning. Short rotations are used. On much of the acreage row crops are grown for many years in succession. Light fertilization is practiced for corn and small grains. The average application is 100 to 150 pounds of 20-percent phosphate or of a mixed fertilizer approximating 0–14–7. Lime has been applied at a rate of 1 to 2 tons an acre for some of the lespedeza and for all areas where red clover has been seeded. Vegetables receive somewhat heavier fertilization, usually about 200 pounds of 4–10–4 and some manure. Moderate applications of lime are also used.

Under these average management practices, corn yields about 45 bushels, wheat 15 bushels, and alfalfa 3.2 tons an acre.

This is one of the most productive soils of the county. It is well suited to a wide variety of crops, including row crops, small grains, alfalfa, and truck crops. It is easily worked and conserved and responds well to fertilization, as its moisture relations exceptionally favor efficient plant growth. Where fertility is kept at a high level, the soil will remain productive under intensive use.

According to information obtained from farmers and others acquainted with this soil, it is feasible to use a rotation consisting of corn followed by a cover crop of crimson clover to be turned under. Another rotation as well suited is corn, a small grain, and then lespedeza or red clover for 2 years. One rotation used consisted of a truck crop (Alaska peas), sown in March and harvested in May, followed by lima beans, sweet corn, or field corn. Where this intensive use was practiced, 200 pounds of 4–10–4 or 4–12–4, with 6 to 10 tons of manure, was considered a good rate of fertilization. Liming every 4 to 6 years is adequate for a cropping system of this kind.

Pasture legumes and grasses such as bluegrass, orchard grass, and white clover produce abundant grazing of high quality under moderate fertilization and adequate liming. Where fertility is kept at a high level, corn will yield about 65 bushels, oats about 50 bushels, and alfalfa about 3.8 tons. Under favorable conditions the carrying capacity of pasture is 145 cow-acre-days, one of the highest rates of any of the soils in the county.

Congaree silt loam, low-bottom phase (0–2% slopes) (Cs.)—This phase differs from Congaree silt loam chiefly in occupying lower positions on bottom lands along the French Broad River. It occurs in places similar to those occupied by the associated low-bottom phase of Congaree fine sandy loam. Like that phase it is more subject to flooding than the higher lying Congaree soils and in places is somewhat darker. It is one of the less extensive of the Congaree soils. It occurs mainly as narrow strips, which are adjacent to the channel and less than 15 feet above the surface of the river. Internal drainage is medium. This is one of the more fertile soils of the county but it is medium to strongly acid. Its content of organic matter is moderately high.

Use and management.—All of the soil has been cleared and is now used mostly for corn. It is suited to intensive use. If adequately fertilized, it can be conserved under a system of farming that uses row crops frequently. Where legumes are to be grown, lime should be applied at moderate rates. Under a high level of management corn will yield about 70 bushels and lespedeza 2.0 tons. The carrying capacity of well-managed pasture is about 145 cow-acre-days.

Cumberland silty clay loam, eroded undulating phase (2–5% slopes) (Cw).—This is a fertile, well-drained, brownish-red soil of the high stream terraces. Like all Cumberland soils, it is in the Cumberland-Huntington soil association area, along the Holston and Tennessee Rivers. It consists of mixed alluvium predominantly from or strongly influenced by limestone. A great part of this soil has been

materially eroded. Much of the plow layer now consists of a mixture of clayey subsoil and the remainder of the original silty surface layer.

Profile description:

0 to 5 inches, brown friable silty clay loam that breaks to firm lumps or clods when dry.

5 to 16 inches, yellowish-red friable silty clay loam.

16 to 36 inches, red or dark brownish-red firm but somewhat friable silty clay; variable material below this consists of an irregular gravelly bed of variegated (reticulated) red and yellow firm silty clay or silty clay loam.

Shale or limestone bedrock is at depths of 4 to 20 feet. In places quartzite cobbles are on the surface and throughout the soil mass in numbers that may be sufficient to interfere with cultivation. Small dark-brown concretions are in the subsoil. A small part of this soil that has not been materially eroded has an 8-inch brown mellow silt loam surface layer.

This soil is high in natural fertility, medium in organic matter content, and medium to strongly acid. Because it is eroded, it is a little lower in fertility and less favorable in tilth than it was originally.

Use and management.—All of this soil has been cleared and is now used for general farm crops, chiefly corn, small grains (pl. 3, *A*), and such legumes as red clover, lespedeza, and alfalfa for hay. Melons, vegetables, and tobacco are common cash crops. Moderately short rotations are ordinarily practiced. Fertilization is generally light, and not much organic matter is returned to the soil. Lime has been applied to a large part of the acreage. The high-value crops such as vegetables, watermelons, and tobacco are given rather heavy applications of commercial fertilizer with moderate quantities of manure. The usual application of commercial fertilizer for these special crops ranges from 500 to 1,000 pounds of 2–12–6, 3–9–5, or 2–8–4. Alfalfa is commonly fertilized and limed when it is seeded. Under ordinary management corn yields about 33 bushels, alfalfa 3 tons, and tobacco 1,500 pounds.

This is one of the most desirable soils for general farm crops and pasture. It is very productive, easily worked and conserved, and suited to a wide variety of crops. It responds well to good management, and, if the organic-matter content is maintained, has a rather high capacity for holding moisture available to plants. Proper conservation requires use of rotations of moderate length, for the soil is slightly subject to erosion when cultivated. A 3- or 4-year rotation consisting of a row crop, a fall-sown small grain, and a legume-grass mixture or alfalfa is suitable. Fertilization, especially with phosphorus, and moderate applications of lime are required to maintain high fertility. Where manure is not added to the soil, legume winter cover crops turned under before the spring planting will aid greatly in keeping the organic-matter content at a reasonable high level. Under such management corn can be expected to yield 57 bushels, oats 60 bushels, and alfalfa 3.8 tons an acre.

This soil is capable of supporting excellent pasture if adequate lime and other plant nutrients, especially phosphorus, are added. White clover, lespedeza, red clover, alfalfa, bluegrass, and orchard grass produce abundant grazing of high quality. If the soil is kept in good condition, its carrying capacity is about 130 cow-acre-days.

Cumberland silty clay loam, eroded rolling phase (5–12% slopes) (Cv).—This soil consists of rolling areas of Cumberland silty clay loam that have not been severely eroded. It is the most extensive of the Cumberland soils. Areas are widely distributed throughout the Cumberland-Huntington soil association along the Holston and Tennessee Rivers and in a few places along the French Broad River. Like the eroded undulating phase, it occupies some of the smoother higher parts of the high stream terraces.

A great part of the acreage has been moderately eroded. The plow layer on more than half of the eroded area consists of a mixture of surface soil and subsoil material. This layer is brown firm silty clay loam; it is underlain by moderately friable silty clay subsoil. A small acreage that has not been eroded materially has an 8-inch brown silt loam surface layer. In places cobblestones are on the surface and in the soil in numbers sufficient to interfere somewhat with tillage. Cobbly areas are indicated on the soil map by appropriate symbol.

In natural fertility and content of organic matter, this eroded rolling phase is somewhat lower than the eroded undulating phase. The soil is medium to strongly acid. Internal drainage is moderate, but the subsoil is sufficiently firm to retard somewhat the absorption of moisture.

Use and management.—Nearly all this phase has been cleared and much of it is now used for crops, mainly corn, small grains, and hay (mostly lespedeza). Red clover and alfalfa are grown to some extent. Vegetables, melons, and tobacco are common but less prevalent than on the smoother Cumberland soils. Rotations lasting 2 to 4 years are not unusual. Some manure and light applications of mixed fertilizer are commonly used for corn and small grains. Moderate quantities of fertilizer and manure are applied for vegetables, melons, tobacco, and alfalfa. Lime has been applied at the rate of about 2 tons an acre. Under ordinary conditions corn yields about 30 bushels, lespedeza 1.0 ton, and alfalfa 2.7 tons an acre.

This productive fertile soil has good capacity for holding moisture available to plants. Its workability and conservability are less favorable than for the eroded undulating phase, as slopes are strong enough to make field operations more difficult and runoff more active. The amount of clayey subsoil material in the plow layer is greater than in the uneroded undulating phase, at least this is true for the more exposed areas. This clayey material causes poor tilth and less favorable conditions for plant growth.

The soil responds well to good management. It can be brought to a fairly high level of productivity for small grains, grasses, legumes, and other general farm crops. It requires moderately long rotations in which close-growing crops predominate, as well as moderate applications of fertilizer and lime. In addition, some special measures for controlling runoff are needed; for example, contour tillage, and in places special means of diverting runoff. Under a high level of management, this phase is capable of producing 55 bushels of corn, 55 bushels of oats, and 3.3 tons of alfalfa. The more desirable pasture legumes and grasses are suited to this soil where adequate lime and fertilizer, particularly phosphate, have been applied. As on a great many of the other soils in the county, alfalfa may require boron. Under favorable management the carrying capacity of pastures will be about 120 cow-acre-days.

253466—55——5

Cumberland silty clay loam, severely eroded rolling phase (5–12% slopes) (Cy).—In this phase are rolling areas, formerly of Cumberland silt loam, from which practically all of the surface soil and, in places, part of the subsoil have been removed by erosion. The soil occurs in small tracts associated with areas of other Cumberland soils in the Cumberland-Huntington soil association along the Holston and Tennessee Rivers. The areas are 30 to 120 feet above the surface of the water. The plow layer consists of red firm silty clay similar to that of the underlying subsoil. Small gullies are common but practically all of them can be crossed with farm machinery and obliterated by tillage.

The content of organic matter in the plow layer and the subsoil is low. The reaction is medium to strongly acid. The supply of mineral plant nutrients is moderately high. Internal drainage is medium, but the firm clay of the plow layer and subsoil retards percolation.

Use and management.—All of the soil has been cleared and cropped at some time. A notable part is idle or in unimproved permanent pasture that supports largely broomsedge, briers, sassafras and persimmon sprouts, and variable amounts of lespedeza intermixed with these. Corn, lespedeza for hay, and small grains are the chief cultivated crops. Small quantities of fertilizer and manure are used, and lime has been applied to much of the soil. A row crop such as corn is grown once every 3 or 4 years; the row crop is followed by small grains and hay. Yields are low. Under ordinary management corn produces 13 bushels, lespedeza 0.5 ton, and oats 15 bushels an acre.

Chiefly because of its heavy or firm plow layer and rolling slope, this soil is not well suited to crops. It is rated as a Third-class soil because it can be made fairly productive of certain crops under good management. Large applications of organic matter, lime, and mineral fertilizer, especially phosphorus, are required to increase fertility, to improve tilth, and to increase the capacity of the soil to absorb and retain moisture for plants. Adequate runoff control will require use of long rotations that consist chiefly of close-growing fall-sown grains, cover crops, and hay and pasture crops. Where these management requirements are met, good production can be expected from the more desirable legumes and grasses such as red clover, alfalfa, timothy, bluegrass, and orchard grass. Tillage on the contour is desirable, and possibly strip cropping. Good management will eventually bring good yields, but probably not so good as on the less eroded soils. The capacity of this soil to hold moisture available for crops was permanently lowered when it lost its mellow silt loam surface layer. Yields of 30 bushels of corn, 33 bushels of oats, and 2.2 tons of alfalfa can be expected. The carrying capacity of pasture can be brought up to about 85 cow-acre-days.

Cumberland silty clay loam, eroded hilly phase (12–25% slopes) (Cu).—This soil consists of hilly areas, formerly occupied by Cumberland silt loam, that have been moderately eroded. It is on high stream terraces consisting of mixed general alluvium that came predominantly from limestone or was strongly influenced by limestone. It is one of the more extensive of the Cumberland soils. Areas of it are widely distributed throughout the Cumberland-Huntington soil association along the Holston and Tennessee Rivers. Much of it

occupies the strong slopes directly below the smoother and highest parts of the stream terraces.

Profile description:

0 to 4 inches, brown or reddish-brown silty clay loam.
4 to 10 inches, yellowish-red firm silty clay loam.
10 to 30 inches, red or dark-red firm but moderately friable silty clay.

The underlying material in places is a gravelly matrix, with limestone or shale bedrock at a depth of about 5 feet. A few areas have not been eroded materially, and in these the surface 6 inches is brown mellow silt loam. A few patches have been so eroded that all of the original silt loam surface soil has been lost and the plow layer is red firm silty clay. In many areas cobbles interfere materially with cultivation. These cobbly areas are indicated on the soil map by appropriate symbol.

This eroded hilly phase is fertile and has a moderate amount of organic matter in the plow layer. It is medium acid. Internal drainage is medium but percolation is sufficiently retarded to cause fairly rapid runoff during rains.

Use and management.—A great part of this soil has been cleared and cropped. More than half is now used for tilled crops, and most of the rest is in pasture. A very small part is idle. Where crops are grown, moderately short rotations are used and a small amount of fertilizer is applied. Lime has been used extensively, and a small quantity of manure has been applied to a little of the soil. Corn, small grains, and lespedeza hay are the common crops. Under common management corn yields 25 bushels and lespedeza 1.0 ton an acre.

Chiefly because of its strong slope and retarded absorption of water, this is considered a Third-class soil. It is suited to long rotations that consist mainly of close-growing crops. Suitable are fall-sown small grains, legume winter cover crops, and such hay and pasture crops as red clover, alfalfa, timothy, orchard grass, bluegrass, and white clover. Where the soil is adequately limed and fertilized and enough organic matter is added, oats should yield 42 bushels and alfalfa 3.1 tons. Pasture that is properly limed, fertilized, seeded, and protected from weedy growth can be expected to produce high quality grazing for about 105 cow-acre-days.

Cumberland silty clay loam, severely eroded hilly phase (12–25% slopes) (Cx).—This soil differs from the eroded hilly phase chiefly in having a more clayey surface soil. It occupies areas from which practically all of the surface soil and, in places, part of the subsoil have been lost through erosion. The plow layer consists of red firm but somewhat friable silty clay subsoil material. There are some gullies, a few of which are difficult or impossible to cross with heavy farm machinery. The larger gullies are indicated on the soil map by appropriate symbol. In places cobblestones interfere with tillage; most areas of this nature are indicated on the map by appropriate symbol.

Fertility is lower than for the less eroded Cumberland soils, although the content of mineral plant nutrients probably is higher than for soils of the Fullerton and Sequoia series. The content of organic matter is low, and the reaction is medium acid. The soil is permeable to roots, but moisture percolation is sufficiently retarded to cause ready runoff during rains.

Use and management.—All of this soil has been cleared and cropped but at present some of it is idle. Common field crops, chiefly corn, small grains, and lespedeza, are grown on a part, and pasture on the rest. Lime has been applied to some of this soil, but little fertilizer has been used and not much organic matter has been returned either in the form of manure or cover crops. Pastures consist chiefly of lespedeza, with some orchard grass, bluegrass, redtop, and white clover intermixed. Under the usual low level of management crop yields are low and the carrying capacity of pasture is about 40 cow-acre-days.

The strong slope and clayey plow layer make this soil poorly suited to crops. It is difficult to work and conserve, and its productivity is low. Liming, adequate fertilization (especially with phosphorus), proper seeding, and control of weeds are required for good pasture. Under proper management the more desirable pasture plants, including bluegrass, orchard grass, and white clover, can be maintained and a carrying capacity of 75 cow-acre-days can be expected.

Cumberland gravelly fine sandy loam, eroded rolling phase (5–12% slopes) (Cr).—This soil occupies high stream terraces. It consists of mixed general alluvium that came predominantly from limestone or was strongly influenced by limestone. A great part of the soil is in the Cumberland-Huntington soil association along the Tennessee River southwest of Knoxville. It differs from the eroded rolling phase of Cumberland silty clay loam chiefly in having a coarser textured surface layer that contains gravel and cobbles in numbers that interfere materially with cultivation. It differs from Waynesboro loam, eroded rolling phase, mainly in having a more uniform red silty clay subsoil that contains less sand.

Profile description:

0 to 8 inches, brown or grayish-brown gravelly fine sandy loam or loam.
8 to 16 inches, yellowish-red friable loam, clay loam, or silty clay loam that may or may not contain gravel.
16 to 36 inches, red or dark brownish-red firm but somewhat friable silty clay; variable material below this consists of either an irregular gravelly bed or of variegated red and yellow firm silty clay or silty clay loam.

Bedrock of the underlying geologic formation, either of shale or of limestone, is at depths of 4 to 20 feet. Small dark concretions are in the subsoil.

The soil is medium to strongly acid and moderate in natural fertility, and quantity of organic matter. Internal drainage is medium. The capacity of the soil to hold nutrients and moisture for plants is favorable.

Use and management.—Practically all of this soil has been cleared and a large part is now used either for crops or pasture. Corn, small grains, and hay predominate. A small acreage is used for vegetables. Moderately short rotations prevail. Light applications of commercial fertilizer or manure are commonly made for row crops and small grains. Vegetables receive moderately large applications. Crop yields under ordinary conditions are a little lower than for Cumberland silty clay loam, eroded rolling phase.

This is a Second-class soil. The high content of gravel interferes with field operations, and the natural fertility is lower than for most First-class soils. Nevertheless, it is more loamy or open and can be tilled sooner following rains than soils with a higher content of clay.

It is therefore preferred for early vegetables. It is well suited to most crops commonly grown, including many truck crops, alfalfa, and the more desirable pasture legumes and grasses. Rotations of moderate length are required, as erosion is active after the soil is tilled. The soil responds well to fertilization. Where adequate plant nutrients, lime, and organic matter have been applied, corn should yield about 48 bushels, oats 42 bushels, and alfalfa 3.1 tons. Good quality pastures can be maintained under such management if proper seeding and control of weeds and brushy growth are practiced.

Dandridge shaly silt loam, eroded hilly phase (12–25% slopes) (DE).—Like other Dandridge soils, this one is grayish and shallow to calcareous shale bedrock. It occurs in landscapes characterized by knobs of shale or black slate. Sharply rounded hilly to steep ridges predominate; they are separated by generally narrow alluvial valley floors. All of this soil is in the Dandridge-Litz-Leadvale soil association in the eastern part of the county north of the French Broad River. All but a small part has been eroded materially. Gullies 2 to 3 feet deep are common in places.

Profile description:

0 to 4 inches, grayish-yellow shaly silt loam.

4 to 18 inches, brownish-yellow or reddish-yellow friable shaly silty clay loam that has a variable quantity of dark-gray or yellowish shale in the lower part; below this a mixture of brownish-yellow soil material and calcareous shale fragments; calcareous (limy) shale bedrock at 1 to 2½ feet.

The thickness of the layers varies greatly according to the degree of erosion. A small part still under native forest has not been subjected to erosion; it has 6-inch surface layer of yellowish-gray silt loam. In contrast, on the most severely eroded parts the brownish-yellow or reddish-yellow friable shaly silty clay loam subsoil is exposed. There are also small low shale outcrops in some of the more eroded spots. In places the shale is soft and weathered and not calcareous to depths of 3 to 8 feet. These areas are inclusions of the Litz series that could not well be delineated separately.

In general, internal drainage is medium, but the capacity of the soil to hold moisture is limited by the shallow depth to bedrock. Fertility is moderate, and the content of organic matter is low. Lime is abundant in most places.

Use and management.—A great part of this soil has been cleared and cultivated. It is chiefly used for pasture, hay, and small grains, but some is idle and a small amount is under reestablished forest, mainly pine. Little fertilization is practiced. Yields are low. Oats yield about 16 bushels, and lespedeza 0.8 ton an acre. Erosion is active in many places.

The soil is poorly suited to crops because it is hilly and shallow to bedrock. It can produce good grass-and-legume pasture. The chief requirements are application of phosphorus and the clipping of weeds and brush. Care is required to prevent gullying. Erosion frequently starts where the soil is excessively trampled or is too thin to support good growth of sod. Areas required for crops should be used in long rotations that consist mainly of fall-sown small grains and grasses and legumes for hay and pasture. Organic matter, nitrogen, and phosphorus are among the chief fertilizer requirements. Field work

done on the contour aids in restraining erosion. Strip cropping and mechanical means of diverting excess runoff are of value in places, but a regular system of terraces is not practical on soils so hilly and shallow to bedrock. Farmers commonly practice subsoiling for either crops or pasture. They do this to increase absorption of moisture and improve permeability of the soil to roots.

If fertility is kept high and a good stand of grasses and legumes is established, the carrying capacity of this soil is about 85 cow-acre-days. Because the soil is droughty or limited in moisture-holding capacity, grazing deteriorates early during dry periods.

Dandridge silt loam, steep phase (25+% slopes) (DG).—This is one of the less extensive Dandridge soils. The separate areas range from 40 to 150 acres in size. They are distributed in the Dandridge-Litz-Leadvale soil association in the eastern part of the county north of the French Broad River.

Use and management.—Practically all of this soil is under native forest consisting chiefly of oaks and second growth of less desirable species such as redbud and ironwood. Strong slope and shallow depth to bedrock render the soil unfit for crops requiring tillage. It is capable of supporting pasture of good quality, although its carrying capacity is limited by its droughtiness. Bluegrass and white clover establish themselves readily where brush and weeds are not allowed to dominate; and if favorable conditions are maintained, they have a carrying capacity of about 70 cow-acre-days.

Dandridge shaly silt loam, eroded steep phase (25+% slopes) (DF).—This is a steep grayish shaly soil, shallow to calcareous shale bedrock. It covers those areas formerly occupied by Dandridge silt loam, steep phase, that have lost much of the surface soil and, in places, part of the subsoil through erosion (pl. 3, *B*). It is one of the more extensive of the Dandridge soils. It occurs in the Dandridge-Litz-Leadvale soil association in the eastern part of the county north of the French Broad River.

Where erosion has not been severe, the plow layer is brownish-yellow silt loam with a small amount of shale intermixed in places. In severely eroded areas the plow layer is brownish-yellow or reddish-yellow friable shaly or very shaly silty clay loam. Below the plow layer is a mixture of brownish-yellow or reddish-yellow silty clay loam soil material and calcareous shale fragments. The thickness of these layers varies greatly, for erosion has removed much more soil material in some places than in others. Calcareous shale bedrock outcrops in places; elsewhere it may reach a maximum depth of about 2½ feet. In a few places, the shale is soft, weathered, and free of lime to depths of 3 or 4 feet. These included areas, representative of the Litz series, could not well be delineated separately.

In general, internal drainage is medium but the capacity of the soil to hold moisture is limited by its high content of shale and shallow depth to bedrock. The natural fertility is moderate, and the content of organic matter is low. Lime is abundant in most places. Gullies are common in places and some are difficult to cross with farm machinery.

Use and management.—All of this soil has been cleared and a great part of it was once cultivated. Much is now in unimproved pasture, a little is cultivated, and some is idle. Little fertilization is practiced.

Productivity is low for the crops and much of the pasture. Commonly the pastures provide about 40 cow-acre-days of grazing.

Strong slopes and shallow depth to bedrock make this soil very poorly suited to tilled crops. Like other Dandridge soils, this phase is naturally capable of producing good pasture. In its present condition, however, most of it will require at least moderate applications of phosphorus and nitrogen, and usually some organic matter, before a good sod of bluegrass and white clover can be established. When this sod is well established, a carrying capacity of about 60 cow-acre-days can be expected. The shallow depth to bedrock causes pastures to dry up quickly during drought, so good grazing is obtained only during the more moist periods.

Dandridge and Litz silt loams, hilly phases (12–25% slopes) (Dc).—In this mapping unit are undifferentiated hilly phases of Dandridge and Litz soils that have not been eroded materially. This is one of the less extensive of the Dandridge-Litz separations. The few areas are chiefly in the Sequoia-Litz-Dandridge and Dandridge-Litz-Leadvale soil associations, mainly in the eastern half of the county. Tracts of this undifferentiated unit range in size from a few acres to 200 or 300 acres. In many places they lie in narrow alternate strips that correspond to strata of the geologic formation from which they are derived. In other places they occupy irregularly interassociated areas. In some areas the Dandridge soils are much less extensive than the Litz, the Litz occupying a great part of the hilly and steep slopes.

Like other undifferentiated Dandridge and Litz soils, these phases are shallow to shale bedrock. A great part of the bedrock is considered to have been originally calcareous, or limy. Now about half of the aggregate area has calcareous shale bedrock directly below the soil—a condition characteristic of the Dandridge soils. In other places the shale, apparently leached of its calcium, is free of lime and is acid to a depth of several feet. This condition is characteristic of the Litz soils. In yet other areas the soils have developed largely from shale varying from practically no lime content to decidedly calcareous, the shale having some thin interbeds of limestone. Dandridge soils are generally less acid than the Litz soils.

The Dandridge soil has a brownish or grayish-yellow silt loam surface layer 6 inches thick. Underlying this to a depth of about 18 inches is brownish-yellow or reddish-yellow friable silty clay loam that has a variable amount of dark-gray or yellowish shale in the lower part. Below this may be a mixture of brownish-yellow soil material and calcareous shale fragments. Bedrock of calcareous (limy) shale is at depths of 1 to 3 feet.

The Litz soil has a 4- to 6-inch surface layer of yellowish-gray silt loam. Below this, in some places, is brownish-yellow or reddish-yellow firm silty clay that grades at 12 or 14 inches to variegated brown, yellow, and red soft partly disintegrated shale and silty clay. In other places the surface layer is underlain by more friable material of brownish-yellow silty clay loam that contains variable amounts of brownish or yellowish soft weathered acid shale. Below depths ranging from 1 to 4 feet is brownish or yellowish soft shale bedrock. Harder dark-gray calcareous shale is generally at depths of 4 to 10 feet.

The Dandridge soil material is moderately fertile and slightly acid to slightly alkaline. The Litz areas are a little lower in fertility and medium to strongly acid to a variable depth, in most places 3 feet or more. The soil material is permeable to roots and moisture, but the shale bedrock greatly retards percolation and root penetration, even though it is much more permeable than the limestones. Moreover, this shale can be disrupted by tillage implements. The capacity of these phases to hold moisture for plants is notably limited.

Use and management.—To large extent these hilly phases are under native forest consisting of deciduous hardwoods, chiefly oaks. Mainly because of their strong slope and shallow depth to shale bedrock, these soils are poorly suited to crops. They are not easily worked and are difficult to conserve when tilled, as runoff develops quickly during rainfall and percolation is slow. The soils are capable of supporting good pasture, however, where their fertility is maintained. Cleared forest areas turned immediately into pasture can be expected to maintain a good cover of bluegrass and white clover. Lime may be needed on some parts (the Litz), and favorable results may be expected if phophorus and nitrogen are applied. Under good management, pasture should have a carrying capacity of 85 cow-acre-days.

Areas required for crops should be used under long rotations consisting largely or wholly of close-growing crops such as fall-sown small grains and legumes and grasses for hay and pasture. A cover of fall-sown small grains or legumes is very desirable when sod crops are not occupying this soil. Contour tillage aids in restraining erosion, and in places mechanical means of diverting runoff may be of value. Terracing is not thought feasible on these shallow hilly soils.

The low water-holding capacity of these soils limits both pasture and crop production. Where the fertility and organic matter are maintained at a relatively high level and soil losses by erosion are held to a minimum, oats can be expected to yield 30 bushels, lespedeza 1.4 tons, and alfalfa 2.6 tons an acre.

Dandridge and Litz shaly silt loams, eroded hilly phases (12–25% slopes) (Da).—This is the most extensive unit of the undifferentiated Dandridge and Litz soils (pl. 4, *A*). It is widely distributed throughout the Sequoia-Litz-Dandridge and Dandridge-Litz-Leadvale soil associations. There are some areas in the Sequoia-Bland and the Sequoia-Leadvale soil associations; particularly north and northwest of Knoxville, that are predominantly Litz soils, as the shale immediately underlying the soil material is leached (or free) of lime. A great part of the acreage in the Sequoia-Litz-Dandridge soil association is approximately half Dandridge and half Litz soils; that is, the shale immediately below the soil material in approximately half the acreage is calcareous, or limy.

These soils consist of hilly areas that have been materially eroded. Where erosion has been moderate, the plow layer is grayish-yellow shaly silt loam for both soils. Where erosion has been severe, it is brownish-yellow or reddish-yellow shaly silty clay loam or shaly silt loam. The underlying material is similar to that described for the hilly phases, except the shale bedrock is nearer the surface in most places.

Internal drainage is moderate throughout, but shale at such a shallow depth greatly impedes movement of moisture and growth of roots to a lower depth. The soils have small capacity for holding moisture available to plants. Fertility is moderate to low, and the reaction varies from moderately acid in the Litz to slightly alkaline in the Dandridge. The content of organic matter is low, and tilth is not favorable in the more eroded clayey parts. The shallow depth to shale and the shale exposures are also unfavorable for tillage, although subsoiling greatly improves tillage by disrupting the shale beds. Gullies are common in the more severely eroded areas or in idle areas where no precautions have been taken to restrain runoff. A few gullies are too large to be crossed by farm machinery, and many such areas are indicated on the soil map by appropriate symbol.

Use and management.—All of these soils have been cleared and cropped at some time. Much is now in pasture and a smaller acreage is idle. A small part is used for crops, chiefly hay, corn, and small grains. A little fertilization is practiced, and some lime has been applied. Pastures have not received much attention and are of low quality; their carrying capacity is about 45 cow-acre-days.

Chiefly because of the strong slope, shallow depth to bedrock, and limited fertility and moisture-holding capacity, these soils are poorly suited to crops requiring tillage. The more desirable pasture grasses and legumes ordinarily produce well where adequate lime, nitrogen, and phosphorus are applied. Areas that must be used for crops require long rotation consisting mainly of close-growing fall-sown small grains and legumes and grasses for hay and pasture. Erosion is a hazard on shallow soils such as this, for removal of even a small amount of soil material greatly affects the productivity. As on the Dandridge soils, subsoiling is beneficial, especially on the thinner areas, for it increases the capacity of the soils to absorb moisture and the amount of material in which plant roots can grow. Where crops are to be grown, heavy fertilization, including application of organic matter and lime, is required if productivity is to be maintained. Under good management oats can be expected to yield 28 bushels, alfalfa 2.4 tons, and pasture 80 cow-acre-days of grazing.

Dandridge and Litz silt loams, steep phases (25+% slopes) (Dd).—In this mapping unit are steep areas of undifferentiated Dandridge and Litz silt loams. Slopes range from 25 to 60 percent. Practically all of these areas are in the Sequoia-Litz-Dandridge and Dandridge-Litz-Leadvale soil associations, which are almost wholly in the eastern half of the county. Much of this mapping unit occurs on short steep slopes below the low smooth ridge tops occupied by Sequoia soils. It is one of the less extensive units of the undifferentiated Dandridge and Litz soils.

The profiles of these silt loams are similar to those of Dandridge and Litz silt loams, hilly phases, except the shale bedrock is generally at a shallower depth. There are a few limestone and shale outcrops, but they are not common to all areas.

Use and management.—In a large part these soils are under native deciduous hardwood forest, chiefly oaks. The steep slope and shallow depth to bedrock make them poorly suited to crops; however, they can support grass-and-legume pastures of a good quality.

Inasmuch as these soils have not been cropped, they are moderately fertile. Pasture vegetation will respond to lime, nitrogen, and phosphorus. If properly fertilized and protected from weeds and brush, these soils have a carrying capacity of about 65 cow-acre-days.

Dandridge and Litz shaly silt loams, eroded steep phases (25+% slopes) (DB).—These soils (pl. 4, *B*) comprise areas, formerly of the uneroded steep phases of Dandridge and Litz shaly silt loams, that have been materially eroded. They are widely distributed throughout the Sequoia-Litz-Dandridge and Dandridge-Litz-Leadvale soil association areas, practically all of which are in the eastern half of the county. The soils are otherwise similar to the complex of hilly phases except that bedrock may be at a shallower depth and bedrock shale and limestone outcrops are more common. Material lost by erosion varies from approximately half of the original surface layer to all of it and a considerable part of the subsoil. In general the soil material is brownish-yellow or reddish-yellow shaly silt loam or shaly silty clay loam. The shale bedrock ranges from low outcrops to a depth of 3 feet. Gullies are common in some places—a few are so deep they are difficult to cross with farm machinery.

Use and management.—All areas of these soils have been cleared and cropped. Much land is now idle, in unimproved pasture, or under volunteer forest, chiefly pine. The eroded condition, shallow depth to bedrock, and steep slope make these soils poorly suited to either crops or pasture. They are low in fertility, have unfavorable tilth, are subject to erosion, and have a small moisture-holding capacity.

Pine forest is easily established in most places and develops a good growth that is useful for timber after a period of years. Areas that must be used for pasture require treatment, especially with phosphorus and lime. It is very necessary to establish an adequate plant cover to protect the soils from further erosion and to maintain good grazing. Lespedeza, white clover, bluegrass, orchard grass, and Bermuda grass are among the better suited pasture plants. After several years of good management, the carrying capacity of such pasture can be expected to be about 50 cow-acre-days.

Decatur silt loam, undulating phase (2–5% slopes) (DK).—Like others of the Decatur series, this is a well-drained soil on relatively smooth limestone valley uplands. In some localities, these uplands are known as mulatto land. The soil developed from high grade limestone and is among the strongest or most fertile in the county. It is one of the less extensive Decatur soils. All areas are in the Decatur-Dewey-Emory soil association, mainly in the southwestern third of the county.

Profile description:

0 to 8 inches, dark-brown silt loam.
8 to 60 inches, brownish-red, grading to red, firm but friable silty clay.
60 inches+, splotched or reticulated red, yellow, and gray, firm silty clay; limestone bedrock at depths of 8 to 20 feet.

Small dark concretions are abundant throughout the subsoil. The surface layer ranges in thickness from 6 to 14 inches. In places there is a small amount of chert, but not enough to affect materially the permeability or tilth of the soil.

This soil is high in fertility and fairly high in organic matter. It is medium to strongly acid. Percolation of moisture is retarded by the firm clayey subsoil, but internal drainage is favorable for crops, and roots easily penetrate all of the soil. The soil has a high capacity for holding moisture available to crops and it retains plant nutrients well. Its tilth is good, although in places the plow layer does not scour well from tillage implements.

Use and management.—Nearly all of this soil has been cleared; only a very small part is under native forest. It is used mostly for corn, small grains, lespedeza, and alfalfa. Some is used for tobacco, vegetables, and red clover. Common rotations are: (1) Corn, 1 year; small grain, 1 year; lespedeza, redtop, and timothy, 2 or 3 years; (2) corn, 1 or 2 years; alfalfa, 5 to 7 years; (3) corn, 1 year (followed by crimson clover turned under); soybeans or cowpeas and millet, 1 year; small grain, 1 year; lespedeza, red clover, and redtop, 2 or 3 years.

Although not fertilized on some farms, corn, as well as small grains, usually receives 75 to 125 pounds an acre of 16- to 20-percent phosphate, 0–10–4, or 2–10–2 fertilizers. Vegetables and tobacco receive heavy applications of manure and 500 to 1,000 pounds an acre of 2–12–6, 2–10–4, 3–9–5, or 3–9–6 fertilizer. Alfalfa, red clover, and bluegrass receive 200 to 500 pounds of some high grade complete fertilizer and 2 to 4 tons of lime an acre at seeding time. Under common management, corn yields 30 to 50 bushels, wheat 18 bushels, lespedeza hay 1.4 tons, alfalfa hay 3.2 tons, and tobacco 1,600 pounds an acre. Bluegrass and white clover do well if lime is applied.

This is one of the most desirable soils of the county for general farming. It is very strong and productive and not difficult to work and conserve. It is particularly suited to corn, small grains, alfalfa, and other legumes, and grasses. It is not among the best soils for truck crops, especially root crops. A more friable or loamy soil with more rapid percolation is preferable for them. Rotations lasting 2 to 4 years are well suited. Some care is needed to restrain erosion on the more sloping parts. Lime is required in moderate amounts, and crops respond to fertilization, especially with phosphorus, nitrogen, and organic matter. Alfalfa requires boron. Where fertility is kept high and good tilth is maintained, corn will yield 62 bushels, oats 65 bushels, alfalfa 4 tons, and tobacco 2,100 pounds an acre. Pastures require chiefly lime, nitrogen, and phosphorus to maintain a growth of excellent quality and high carrying capacity. Under proper management the carrying capacity is about 140 cow-acre-days.

Decatur silty clay loam, eroded undulating phase (2–5% slopes) (DN).—This is one of the more extensive of the Decatur soils and is widely distributed throughout the Decatur-Dewey-Emory soil association. It consists of areas, formerly of the uneroded undulating phase, that have lost enough of the surface soil by erosion to leave the subsoil within plow depth in more than half the area. Separate tracts range from 6 acres to more than 50 acres in size.

The plow layer is dark-brown or reddish-brown silty clay loam. Below this is the brownish-red firm but friable silty clay subsoil. Limestone bedrock is at depths of 5 to 30 feet. The plow layer, however, varies according to degree of erosion. Where erosion has been less active, the original dark-brown silt loam surface layer, with little

or no subsoil intermixed, may be 6 to 10 inches thick. On the other hand, there are patches where practically all of the surface layer has been removed and the plow layer is brownish-red firm silty clay. The range in depth to bedrock is greater than for the undulating phase. The areas having the shallowest depth (5 to 8 feet) are in the vicinity of Corryton, where there are no areas of the relatively uneroded undulating phase.

Use and management.—All of this soil has been cleared and virtually all is now used for crops. Rotations lasting 3 to 5 years prevail and some fertilization is practiced. Corn, small grains, lespedeza, and alfalfa are the most common crops. Use and management are practically the same as for the undulating phase and average yields are slightly lower.

Like the undulating phase, this is one of the most desirable soils of the county for general farming. Its productivity is a little lower, however, and its ability to absorb and hold moisture is less. Tilth is good but tillage should be avoided when the soil is either too moist or too dry. The soil is well suited to corn, small grains, and grasses and legumes for hay and pasture, including alfalfa. It is not among the best soils for truck crops because it has a rather heavy consistence. Three- and four-year rotations are well suited. Some care is required to restrain erosion. Winter cover crops are particularly valuable in protecting the soil from runoff during winter. Lime, organic matter, and phosphorus are the chief fertilizer requirements. If the supply of plant nutrients is at a high level and good tilth is maintained, corn yields 55 to 60 bushels, oats 60 bushels, and alfalfa 3.8 tons an acre. High quality pastures consisting of white clover, bluegrass, and orchard grass can be maintained easily where adequate lime and phosphorus are supplied.

Decatur silt loam, rolling phase (5–12% slopes) (DH).—This is a dark reddish-brown well-drained soil on the sloping or rolling upland parts of the limestone valleys. It is one of the less extensive of the Decatur soils and is distributed in the Decatur-Dewey-Emory soil association. This phase is similar to the undulating phase except it has a strong slope. Ordinarily the surface 6 to 8 inches is dark-brown silt loam and the subsoil is brownish-red to red firm but friable silty clay. Limestone bedrock is at depths of 7 to 20 feet.

The soil is fertile and has a fairly high content of organic matter. It is medium to strongly acid. Percolation of moisture is retarded by the firm clayey subsoil, but internal drainage is favorable for crops and roots penetrate all of the soil easily. The soil has a high capacity for holding moisture for crops and retains plant nutrients well. Its tilth is good, although in places the plow layer does not scour well from tillage implements. Tillage should be avoided when the soil is too moist to work without clodding or puddling.

Use and management.—Nearly all of this soil is cleared; only a small part is under native forest. It is used chiefly for corn, small grains, lespedeza, and alfalfa. Some is used for tobacco and red clover and a small acreage for vegetables and other truck crops. Three- to five-year rotations prevail. Sometimes the corn is not fertilized, especially when it follows a legume hay crop. Small grains commonly receive 75 to 125 pounds an acre of 20-percent phosphate, 0–10–4, or 2–10–2 fertilizer. Alfalfa and red clover receive 200 to 500 pounds an acre of

high grade mixed fertilizer and 2 to 4 tons of ground limestone at seeding time. Ordinarily some manure is applied at intervals of 3 to 5 years. On some farms this treatment is lacking. Some farmers turn under a legume cover crop, but this is not generally done. Under common management corn yields 35 bushels, oats 37 bushels, and lespedeza 1.3 tons an acre.

This silt loam is strong soil well suited to general farming; it is productive of small grains, corn, and the more desirable legume-and-grass hay and pasture crops. It also produces tobacco. Its heavy consistence makes it less suited to most truck crops than some of the more friable loamy soils. Moderately long rotations lasting 4 to 5 years are required if productivity is to be maintained. Close-growing crops such as fall-sown small grains and legume-and-grass hay help protect the soil from erosion. Winter-legume cover crops planted following row crops also aid in protecting the soil and maintaining its content of nitrogen and organic matter. Crops generally respond well to moderately heavy fertilization and liming. Alfalfa will respond to boron. Under a system of management consisting of moderately long rotations, adequate fertilization and liming, and maintenance of the organic-matter content, corn can be expected to yield 55 to 60 bushels, oats 60 bushels, and alfalfa 3.8 tons. Well fertilized and limed pasture of bluegrass and white clover has a carrying capacity of about 125 cow-acre-days.

Decatur silty clay loam, eroded rolling phase (5–12% slopes) (DM).—Areas of the rolling phase now so eroded that the subsoil is within plow depth make up this phase. This is one of the most extensive of the Decatur soils; it is widely distributed throughout the Decatur-Dewey-Emory soil association. Separate areas range from 10 to 80 acres or more in size.

The plow layer consists of dark-brown to reddish-brown silty clay loam. Below this is brownish-red firm but friable silty clay, grading at about 50 inches to splotched or reticulated red, yellow, and gray firm silty clay. Limestone bedrock is at depths of 4 to 20 feet. Small dark concretions are abundant throughout the subsoil. The surface layer, where less eroded, is dark-brown silt loam from 6 to 8 inches thick. Where erosion has been exceptionally active, the plow layer may consist entirely of brownish-red firm but friable silty clay subsoil material. The areas having the shallowest depth to bedrock are in the vicinity of Corryton.

This is one of the most fertile soils of the county, though somewhat less fertile than the uneroded Decatur soils. The reaction is medium acid and the organic-matter content is fairly high. Percolation is retarded by the firm silty clay subsoil, but internal drainage is favorable. Roots penetrate all of the soil easily. The capacity of the soil to hold moisture available to crops is moderately high, but the rolling surface and relatively shallow depth to the firm silty clay subsoil cause runoff to develop quickly during rains. Tilth is fairly good, although tillage should be avoided when the soil is too moist or too dry.

Use and management.—All of this soil is cleared. The most common crops are corn, small grains, lespedeza, and alfalfa. Common rotations are: Corn, 1 year; small grain, 1 year; lespedeza, redtop, and timothy, 2 or 3 years; (2) corn, 1 or 2 years; alfalfa, 5 to 7 years.

Corn and small grains generally receive 75 to 125 pounds an acre of 20-percent phosphate, 0–10–4, or 2–10–2 fertilizers. Corn is not fertilized on some farms. Alfalfa, red clover, and bluegrass receive 200 to 500 pounds an acre of some high grade complete fertilizer and 2 to 4 tons of ground limestone an acre at seeding time. For rotations including alfalfa or red clover, 2 to 3 tons of ground limestone is commonly applied at intervals of 6 to 10 years. Under common management, corn yields about 30 to 35 bushels, wheat 16 bushels, lespedeza hay 1 to 1½ tons, and alfalfa hay 2.8 tons an acre.

This soil is well suited to crops that require tillage. It is very productive and easy to work but somewhat more difficult to conserve than Decatur silt loam. Judicious use of lime, fertilizers, and moderately long rotations that include crops that provide winter cover, organic matter, and nitrogen, are necessary for the conservation of plant nutrients and soil material. Contour tillage, strip cropping, and terracing may help in controlling runoff. Some farmers practice subsoiling to increase the capacity of the soil to absorb moisture. Crops such as soybeans and cowpeas leave the soil loose and bare, which favors erosion losses during the winter. Where a high level of fertility is maintained adequate organic matter and lime are supplied, and tilth is kept favorable, corn yields 55 bushels, oats 55 bushels, and alfalfa 3.4 tons. Legume-and-grass pasture, under favorable conditions, has a carrying capacity of about 125 cow-acre-days.

Decatur silty clay loam, severely eroded rolling phase (5–12% slopes) (DP).—In this phase are former areas of Decatur silt loam, rolling phase, from which erosion has removed most, or all, of the surface soil, and, in places, part of the subsoil. It is widely distributed throughout the Decatur-Dewey-Emory soil association. The separate areas are small; most of them range from 5 to 25 acres. The plow layer, consisting of brownish-red firm but friable silty clay loam, is similar to the underlying subsoil. Limestone bedrock is at depths of 4 to 15 feet. Small gullies are common, but many are obliterated by tillage and practically all can be crossed with farm machinery.

Fertility is moderate, organic-matter content low, and the reaction medium to strongly acid. Percolation is slow, although roots penetrate the soil under favorable moisture conditions. The soil puddles or clods easily and has a narrow moisture range favorable for tillage.

Use and management.—All of this soil has been cleared and cultivated. A small part is now used for corn, but most is in pasture or hay. Corn, small grains, lespedeza, and redtop are the most common crops. Alfalfa and bluegrass are also grown. Many pastures consist chiefly of lespedeza, redtop, bluegrass, wild grasses, and weeds.

The most common rotation is corn, 1 year; small grain, 1 year; lespedeza and grasses, 2 to 4 years. Corn and small grains generally receive 75 to 125 pounds an acre of 20-percent phosphate, 0–10–4, or 2–10–2 fertilizer. Alfalfa receives stable manure, 200 to 500 pounds of commercial fertilizer, and 2 to 4 tons of ground limestone an acre at seeding time. Pastures commonly receive 2 to 3 tons of ground limestone an acre each 6 to 10 years. Crop yields are low unless special attention is given to improving fertility and tilth and controlling runoff. Corn yields 10 to 15 bushels, wheat 7 bushels, lespedeza hay 0.5 ton, and alfalfa hay 1.5 tons an acre.

Because of its low fertility, strong slope, and heavy plow layer, this soil is not well suited to tilled crops. Conserving fertility, good tilth, and soil material is difficult. Nevertheless, with proper management, this soil can be brought to fairly high productivity and eventually used as cropland. Particular care must be taken to restore organic matter, control runoff, and increase fertility. Practices needed for proper conservation are deep tillage, substantial applications of lime and phosphate, and use of rotations consisting chiefly of close-growing crops that will supply organic matter, winter cover, and nitrogen. In some circumstances the use of mechanical means of water control may be warranted; in others use of the soil for pasture a number of years may be more feasible. After a period of good management, corn should yield 30 bushels, oats 33 bushels, alfalfa 2.3 tons, and pasture 85 cow-acre-days of grazing.

Decatur silty clay loam, eroded hilly phase (12–25% slopes) DL).—This is a reddish-brown moderately eroded and hilly soil of the limestone valley uplands. It is distributed in the Decatur-Dewey-Emory soil association. The separate areas are not large and many of them lie as sloping strips adjacent to and below smoother Decatur soils. The soil is distinguished from Decatur silt loam, undulating phase, chiefly by its much stronger slopes and loss of enough surface soil to bring the subsoil within plow depth in more than half the area. The parent rock is high grade limestone.

Profile description:

0 to 4 inches, reddish-brown friable silty clay loam.
4 to 60 inches, brownish-red firm but friable silty clay.
60 inches+, splotched or reticulated red, yellow, and gray firm silty clay; limestone bedrock at depths of 4 to 15 feet.

The surface soil varies according to the degree of erosion. Small less eroded parts have a dark-brown silt loam surface layer 5 to 8 inches thick. On the other hand, there are small areas where all of the surface layer has been removed and the plow layer is brownish-red firm silty clay.

The soil is medium to strongly acid. It is moderately high in fertility, although the content of organic matter and nitrogen is less than it was before the loss of surface soil through erosion. Internal drainage is medium. The subsoil, though firm enough to retard infiltration of water, is permeable to roots. The capacity of the soil to hold moisture available to plants is moderate, and the strong slope and retarded percolation cause runoff to develop quickly during rains. Tilth is fairly good, although tillage should be avoided when the soil is too moist or too dry.

Use and management.—All of this soil has been cleared and most of it has been cropped for many years. Corn, small grains, and lespedeza are the most common crops. Alfalfa is grown to some extent. Pastures consist chiefly of lespedeza, redtop, and Bermuda and other volunteer grasses. Bluegrass is common in places. Shorter rotations than are suitable are commonly used, and the fertilization practiced is usually not adequate to maintain high fertility. Some lime has been applied to much of the acreage, and a small amount of manure is used. Under ordinary conditions corn yields 27 bushels, lespedeza 1.0 ton, and alfalfa 2.6 tons an acre.

Strong slopes and retarded percolation make this soil poorly suited to intensive use for row crops. Its high natural fertility, moderately favorable moisture relations, and ability to retain plant nutrients make it well suited to long rotations consisting principally of small grains and grasses and legumes for hay and pasture. Increasing the supply of organic matter, regular fertilization and liming, and use of some practices for supplemental water control are necessary if high productivity is to be maintained. This soil is productive of pasture. A great many areas not required for crops could well be used for permanent pasture. If adequate phosphorus and lime are applied, bluegrass, Bermuda grass, and white clover pasture easily can be established. Under good management corn yields 45 bushels, oats 45 bushels, and alfalfa 3.2 tons an acre. Pasture has a carrying capacity of about 110 cow-acre-days.

Decatur silty clay loam, severely eroded hilly phase (12–25% slopes) (Do).—This phase consists of hilly Decatur soil that has been so much erodod that all of the original surface soil and in places part of the subsoil have been removed. The plow layer consists of brownish-red firm but friable silty clay loam that grades to silty clay. This layer grades to splotched or reticulated red, yellow, and gray firm silty clay at about 48 inches; limestone bedrock is at depths of 4 to 12 feet.

The soil is medium to strongly acid. Its fertility is medium, and the content of nitrogen and organic matter is much lower than in the less eroded Decatur soils. Tilth is unfavorable, and though internal drainage is medium, infiltration of moisture is notably retarded and runoff accumulates rapidly during rains. The moisture-holding capacity is limited and the soil is therefore droughty.

Use and management.—All of this soil has been cleared and cropped. A small part is now used for corn but most of it is in pasture or hay. Some small grain is grown. Pastures consist chiefly of lespedeza, redtop, and in places Bermuda grass, bluegrass, and white clover. Rotations are moderately long and most crops receive some fertilizer or a little manure. Much pasture has been limed and some phosphorus has been applied at the rate of 200 pounds of 20-percent phosphate an acre.

This soil is exacting in its management requirements, chiefly because of its strong slope, slow permeability, and poor tilth in the plow layer. It is not suited to tilled crops but is capable of producing a limited amount of good quality grazing if it is adequately fertilized and limed. Its droughtiness limits the period in which pasture grows well. The carrying capacity of pasture, even under good management, is about 75 cow-acre-days, or approximately 30 percent lower than for the less eroded hilly phase. Areas of this soil needed for crops require a long period of rejuvenation and very careful management if high productivity is to be developed and maintained. Organic matter, phosphorus, nitrogen, and lime are required. Maintenance of a close-growing cover, including legumes, with a minimum of tillage is one of the necessary management practices.

Dewey silt loam, undulating phase (2–5% slopes) (Ds).—This reddish soil of the limestone valley uplands, like the associated Decatur soils, has developed over high grade limestone. A few small tracts of it occur in the Decatur-Dewey-Emory soil association. This

soil, like other Dewey soils, differs from the Decatur soils chiefly in having a lighter brown surface layer and a lighter red slightly more friable subsoil. Dewey soils are greater in aggregate area than the Decatur and are a little lower in natural fertility. Their deep subsoil commonly contains a small quantity of fine chert fragments, whereas Decatur soils are more nearly free of this material.

Profile description of Dewey silt loam, undulating phase:

0 to 8 inches, grayish-brown silt loam.
8 to 24 inches, yellowish-red firm but friable silty clay loam.
24 to 50 inches, yellowish-red to red firm but friable silty clay.
50 inches+, splotched or reticulated, red, yellow, and gray firm but friable silty clay.

Small dark concretions are common throughout the subsoil and usually a few small chert fragments occur in the lower subsoil. Limestone bedrock is at depths of 8 to 25 feet.

The organic-matter content is moderately high but less than for Decatur silt loam, undulating phase. The reaction is medium to strongly acid and the natural fertility is relatively high. Internal drainage is medium, although infiltration of water is somewhat retarded by the firm clayey subsoil. The soil is easily penetrated by roots and has a high capacity for holding moisture available to plants.

Use and management.—Practically all of this soil is cleared and used for crops, chiefly corn, small grains, lespedeza, redtop, and alfalfa. Tobacco and truck crops are grown on a small acreage. Some of the soil is pastured, usually as a part of a crop rotation. Rotations lasting 2 to 4 years prevail. Manure is used on farms where livestock is raised. Mixed fertilizer is applied in small amounts for corn and small grains and in fairly large amounts for alfalfa, tobacco, and truck crops. Ground limestone has been applied to most of the acreage at the rate of 1½ to 2 tons an acre. Under ordinary conditions corn yields 35 bushels, wheat 16 bushels, and alfalfa 3.1 tons.

This is one of the most desirable soils of the county for general farm crops and pasture. It is one of the better soils for alfalfa and red clover. It is productive and easily worked and conserved. Where fertility and organic-matter content are kept high and care is taken to control runoff, this soil is suited to moderately short rotations. It can support a row crop once in 2 or 3 years. The soil responds well to heavy fertilization. Organic matter, phosphorus, and lime are the chief fertilizer requirements, except that alfalfa may also require boron. The more sloping parts lose some soil material when close-growing crops are not maintained, and particular care may be required to stop runoff. Use of contour tillage and winter cover crops and, on some farms, terracing will help reduce erosion.

Under good management corn yields 60 bushels, wheat 26, alfalfa 3.8 tons, and tobacco 2,000 pounds an acre. This soil is very well suited to grasses and legumes for pasture. Where fertility and lime requirements are adequately met, the carrying capacity of pastures is about 135 cow-acre-days.

Dewey silty clay loam, eroded undulating phase (2–5% slopes) (Dw).—This is one of the more extensive soils of the Dewey series and one of the predominant soils in the Decatur-Dewey-Emory soil association. The moderately large separate tracts generally range from 15 to 60 acres in size. The soil occupies areas formerly occupied

by the undulating phase that are now so eroded that subsoil material is within plow depth on half or more of the area.

The plow layer is grayish-brown moderately friable silty clay loam. Below this is yellowish-red firm to friable silty clay loam, which is underlain at a depth of about 20 inches by yellowish-red to red firm but friable silty clay. Limestone bedrock is at depths of 8 to 25 feet. In small more exposed patches the original surface soil has been removed by erosion and the plow layer is firm yellowish-red silty clay.

This is a fertile soil, although its organic content is a little lower than that of the undulating phase. It is medium to strongly acid. Internal drainage is medium, but infiltration of water is retarded somewhat by the firm silty clay subsoil. As a result runoff develops a little more quickly during rains than on the undulating phase. The soil is permeable to roots and has a rather high capacity for holding moisture for plants. The eroded condition makes the tilth a little less favorable than that of the undulating phase.

Use and management.—All of this soil has been cleared and a large part is now used for crops or pasture. Corn, small grains (pl. 5, *A*), lespedeza, alfalfa, and red clover are among the more common crops; tobacco and truck crops are also grown. Moderately short rotations are generally used, and, except for short periods, very little of the soil is under pasture. A small amount of manure is used on farms where livestock is raised. Light applications of mixed fertilizer are used regularly for corn and small grains, but moderately heavy applications, along with manure, are used for tobacco and truck crops. Alfalfa commonly receives fairly adequate fertilization and lime at seeding time. Under ordinary conditions corn yields 30 bushels, wheat 15, and alfalfa 2.9 tons.

Like the (uneroded) undulating phase, this is one of the most desirable soils of the county for the production of practically all crops commonly grown and for pasture, especially alfalfa. It is easily worked and conserved. Chiefly because of the somewhat slower rate of infiltration, the soil is a little more susceptible to erosion, and therefore more care is needed to control runoff. This soil is suited to 3- or 4-year rotations where the fertility and organic-matter content are kept at a high level, good tilth is maintained, and runoff is controlled. Under such management crop yields can be expected to approach those of the undulating phase. If a high fertility is maintained, legume-and-grass pastures produce high quality grazing with a carrying capacity of 125 cow-acre-days.

Dewey silt loam, rolling phase (5–12% slopes) (Dr).—The small tracts of this inextensive soil are distributed throughout the Decatur-Dewey-Emory soil association. The surface layer consists of grayish-brown silt loam and may be a little thinner than that of the undulating phase. The subsoil, below a depth of 5 to 8 inches, is yellowish-red firm but friable silty clay loam. This grades at about 20 inches to yellowish-red or red firm but friable silty clay that becomes splotched red, yellow, and gray below 50 inches. High grade limestone bedrock is 8 to 25 feet below the surface.

This fertile soil has a moderately high content of organic matter and is medium to strongly acid. It has good tilth and a high capacity for holding moisture available to plants. Although the rate of infiltra-

tion is somewhat retarded by the firm clayey subsoil, internal drainage is medium and the soil is easily penetrated by plant roots.

Use and management.—Much of this soil is used as permanent pasture. Small portions are under native hardwood forest. The cropped acreage is used chiefly for corn, small grains, and hay in moderately long rotations.

This is among the more desirable soils for the production of crops, especially alfalfa. Chiefly because of its stronger slope, it is less suited to row crops than the undulating phases. Proper management requires use of moderately long rotations in which close-growing fall-sown small grains and legumes and grasses predominate. Row crops should not be grown more often than once in 4 to 5 years. Care is required to control runoff adequately. The soil therefore should be occupied as long as possible by close-growing crops. Winter cover crops are of especial value following a row crop. Performing field operations, especially cultivation, on the contour greatly aids in reducing erosion. The soil responds well to fertilization, including application of organic matter and lime. Where the fertility is maintained at a high level in moderately long rotations, corn yields 55 bushels, wheat 25 bushels, and alfalfa about 3.6 tons an acre. Pastures of good quality are easily maintained when properly fertilized, especially with phosphorus and lime, and have a carrying capacity of about 125 cow-acre-days.

Dewey silty clay loam, eroded rolling phase (5–12% slopes) (Dʊ).—This is one of the more extensive Dewey soils; it is widely distributed in the Decatur-Dewey-Emory soil association in tracts of 10 to 60 acres. It comprises areas of Dewey silt loam, rolling phase, that have been so eroded that subsoil material is within plow depth in more than half the area.

The plow layer is generally a grayish-brown silty clay loam. Below this is subsoil material like that described for the rolling phase. Limestone bedrock is at depths of 8 to 25 feet. The surface, or plow layer varies notably. In the least eroded places it is grayish-brown silt loam, and on the most eroded parts it consists of yellowish-red firm silty clay.

Use and management.—All of this soil has been cleared and cropped. It is used chiefly for corn, small grains, lespedeza, grasses, and alfalfa. A small part is used for tobacco and vegetables. Rotations generally last 3 to 4 years. Most areas have been treated with ground limestone at the rate of 2 or 3 tons an acre. Corn and small grains commonly receive from 75 to 125 pounds an acre of 20-percent phosphate, or its equivalent, or 0–10–4 or 2–10–2 mixed fertilizer. Alfalfa commonly receives some manure, 300 to 500 pounds of high grade fertilizer, and 2 to 4 tons of ground limestone an acre at seeding time. Vegetables and tobacco receive relatively heavy applications of mixed fertilizer, generally from 500 to 1,000 pounds an acre of 2–12–6, 3–9–5, or 2–8–4, along with moderately heavy applications of manure. Under ordinary conditions, corn yields about 28 bushels, wheat 14 bushels, and alfalfa 2.7 tons an acre.

This is one of the more desirable soils of the county for general farm crops. Nevertheless, its moderately strong slope makes management more exacting than for the undulating phases. It is a little more diffi-

cult to work and conserve. Moderately long rotations are generally required, as row crops cannot be grown frequently without subjecting the soil to undue erosion hazard. Alfalfa is one of the better suited crops. Truck crops are among those more poorly suited. Field operations designed to restrain erosion are necessary. Close-growing crops should occupy the soil as long as possible. When tillage must be done, it should be done on the contour. In places strip cropping or terracing may be of value in controlling runoff.

The soil responds well to heavy fertilization and liming. Where fertility and organic-matter content are kept at a high level, corn should yield 53 bushels, wheat 24 bushels, alfalfa 3.3 tons, and tobacco 1,800 pounds an acre. Where the fertility is kept high, pastures of high quality can be produced. Bluegrass, orchard grass, Bermuda grass, and white clover or other pasture legumes grow well under good management and have a carrying capacity of about 120 cow-acre-days.

Dewey silty clay loam, severely eroded rolling phase (5–12% slopes) (Dy).—The separate areas of this soil are small and widely distributed throughout the Decatur-Dewey-Emory soil association. The soil consists of tracts, formerly of Dewey silt loam, rolling phase, that have lost practically all of the original surface soil through erosion. The plow layer is now composed of yellowish-red firm silty clay loam or silty clay. The subsoil is yellowish-red to red firm but moderately friable silty clay. Limestone bedrock is at depths of 6 to 20 feet.

Internal drainage is slightly impaired and the rate of infiltration is notably retarded as compared with that for uneroded Dewey soils. Since the capacity for holding moisture available to plants is small, the soil is relatively droughty. The content of organic matter is low and the reaction is medium to strongly acid. There are a few small gullies, but practically all of these are crossable with farm machinery and many are obliterated by moderately deep tillage.

Use and management.—All of this soil has been cleared and cropped, but at present only a small part is cultivated. Most of the soil is used as unimproved pasture and a small part is idle. Not much fertilizer is put on pasture, but the limited crop acreage receives light applications. Moderate applications of lime have been made on most of the soil. Moderately short rotations are used on cropland. Corn yields about 13 bushels, wheat 6, and lespedeza 0.5 ton an acre. Pasture under average conditions is not especially productive and consists of lespedeza, crabgrass, and broomsedge.

This soil has low productivity chiefly because of its firm clayey plow layer. The poor tilth and moderately strong slope make it difficult to work and conserve. It is considered suitable for the general farm crops and pasture but its management is exacting. If the productivity of this soil is to be brought to a high level, much organic matter, as well as heavy applications of fertilizer and lime, will be necessary. Close-growing crops should occupy the soil as much as possible; consequently, rotations lasting 5 to 7 years or longer should be used. Permanent pasture consisting of bluegrass, orchard grass, and white clover is particularly well suited. After the fertility has been brought to a high level, alfalfa can be established and maintained for periods of several years.

When row crops must be grown, great care should be taken to cultivate on the contour. Legume cover crops that immediately follow a row crop are of great value in restraining erosion during winter. After several years of rejuvenation, the soil will yield about 26 bushels of oats and 2.1 tons of alfalfa an acre. Good quality pasture with a carrying capacity of about 80 cow-acre-days can be expected after a few years, if proper seeding and adequate fertilization and liming have been carried out.

Dewey silty clay loam, eroded hilly phase (12–25% slopes) (DT).—This soil is widely distributed throughout the Decatur-Dewey-Emory soil association. The separate areas cover 5 to 25 acres and many of them lie as strongly sloping strips or belts below smoother Dewey and Decatur soils. This phase comprises the hilly areas of Dewey soils that are slightly or moderately eroded.

Much of the acreage has subsoil material within plow depth. The plow layer is grayish-brown or yellowish-brown silty clay loam formed through mixing of remnants of original surface soil with subsoil material. The subsoil is yellowish-red to red firm but friable silty clay with splotches of red, yellow, and gray below 45 inches. High grade limestone bedrock is at depths of 6 to 20 feet. The small part of this phase not materially eroded has a 6-inch grayish-brown silt loam surface layer.

Natural fertility is high, and the organic-matter content is moderately high. The reaction is medium to strongly acid. Internal drainage is medium, and the soil is easily penetrated by roots. Infiltration of water is somewhat retarded by the firm silty clay subsoil, but the capacity for holding mositure available to crops is moderately high.

Use and management.—A great part of this soil has been cleared and cropped. Corn, small grains, and hay, chiefly lespedeza and red clover, are the more common crops. Some alfalfa is grown, and small acreages of tobacco or truck crops. Pasture occupies a sizable acreage. Corn and small grains receive some fertilizer, and a large part of the soil has been limed at a rate of 2 to 4 tons once every 6 to 10 years. Rotations lasting 3 to 5 years are usual on cropland. Under common management crop yields may be a little lower than on Decatur silty clay loam, eroded hilly phase.

High fertility and favorable internal conditions make this soil productive of the crops commonly grown, but its strong slopes and retarded rate of infiltration necessitate exacting management. This soil should be protected by live vegetation, as runoff is very erosive. Long rotations lasting 5 to 7 years or more are well suited; they should consist chiefly of close-growing crops, such as fall-sown small grains and grasses and legumes for hay and pasture (pl. 5, *B*). The soil responds well to heavy fertilization. Phosphorus, lime, and organic matter are especially needed in building high productivity. Tillage on the contour, and probably strip cropping, is a practical aid in restraining runoff. Areas not required for crops may well be used for permanent pasture. If adequately fertilized and seeded, pasture is of high quality and has a carrying capacity of about 105 cow-acre-days.

Dewey silty clay loam, severely eroded hilly phase (12–25% slopes) (Dx).—The small separate areas of this soil occur for the

most part as strongly sloping strips below smoother Dewey and Decatur soils. The areas are distributed throughout the Decatur-Dewey-Emory soil association. The soil consists of hilly areas so eroded that the surface soil and in places part of the subsoil have been lost. The plow layer is yellowish-red to red firm but moderately friable silty clay loam or silty clay. Below this is yellowish-red silty clay, which is splotched with red, yellow, and gray below a depth of about 40 inches. Limestone bedrock is at depths of 5 to 15 feet.

The soil is strongly sloping. Internal drainage is somewhat impaired. Slow infiltration causes runoff to develop quickly during rains, but roots readily penetrate. The plow layer has unfavorable tilth, and because it is firm and clayey, the capacity of the soil to hold moisture for plants is greatly reduced. The soil is medium to strongly acid. Gullies occur in places and some are difficult or impossible to cross with heavy farm machinery.

Use and management.—All of this soil has been cleared and cropped. Pasture now occupies a great part. Corn, small grains, and hay, chiefly lespedeza, predominate on the cropland. Small tracts are commonly allowed to rejuvenate as unimproved pasture or idle land for several years and are then cropped for a few years. Little fertilization is practiced but a moderate amount of lime has been applied to a large part of the soil. Under average management pasture is of fair quality and has a carrying capacity of about 40 cow-acre-days. Lespedeza, broomsedge, and crabgrass are among the predominant pasture plants, although bluegrass, Bermuda grass, and white clover are more common on the better managed pastures.

Strong slopes and the unfavorable tilth, poor moisture relations, and rather low fertility of the plow layer make this soil poorly suited to tilled crops. Where organic matter is added and the general fertility is raised to a high level, pasture and more permanent hay crops such as alfalfa are well suited. Under a high level of management that includes adequate fertilization, pasture plants such as Bermuda grass, bluegrass, orchard grass, and white clover produce grazing of good quality for about 75 cow-acre-days. Alfalfa can be expected to yield 2.0 tons an acre. After a prolonged period of rejuvenation under legumes and grasses, growing of tilled crops may be feasible if a very long rotation is used.

Dewey silty clay loam, eroded steep phase (25+% slopes) (Dv).—This soil occurs mainly as strongly sloping narrow strips below areas of smoother Dewey and Decatur soils; all tracts are within the Decatur-Dewey-Emory soil association. The soil resembles the eroded hilly phase except for having stronger slopes and small severely eroded area.

The plow layer differs according to the extent of erosion. Where subsoil and surface soil are mixed, it is predominantly a grayish-brown to dark-brown silty clay loam. Where it consists solely of subsoil material, it is yellowish-red to brownish-red firm but moderately friable silty clay. The subsoil is yellowish-red to brownish-red silty clay. Limestone bedrock is at depths of 5 to 15 feet. The areas with the darker brown surface represent a small acreage of Decatur soils on steep slopes; they have been included with this eroded steep phase because small extent and similarity of profiles.

Internal drainage for most of this soil is slightly impaired, but the entire soil is permeable to roots. Notably retarded infiltration of moisture on the more eroded parts, together with the strong slope, causes runoff to develop quickly and become actively erosive on those areas not protected by a luxuriant cover of close-growing plants. The natural fertility is high and the content of organic matter is moderately high. The entire soil is medium to strongly acid.

Use and management.—A small part of this phase is still under native hardwood forest but most of it has been cleared and used for crops at some time. A small part, mostly severely eroded, is now idle. A great part is used for pasture. The productivity of the acreage formerly cropped is usually moderate to low, as fertilization is seldom adequate. Some lime has been applied, and a part of the pasture is kept productive. Pastures on the more eroded parts generally are only fair and rather low in carrying capacity.

Chiefly because of its strong slope, this soil is poorly suited to tilled crops. Some areas can be made productive of good grazing by adding adequate fertilizer and lime. The severely eroded acreage, however, will require a relatively long period of rejuvenation, during which the organic-matter content and general fertility will increase. After this period, good quality pasture with a carrying capacity of about 100 cow-acre-days can be established. The unfavorable moisture relations of the clayey surface layer or plow layer cause this soil to be droughty, at least in the more eroded parts. Pasture plants therefore suffer early during dry periods.

Emory silt loam, undulating phase (2–5% slopes) (Ec).—This brown well-drained soil is derived from local alluvium or colluvium. It occurs in areas occupied predominately by Decatur, Dewey, Farragut, and some of the Fullerton soils. The surface is gently sloping. The separate areas for the most part lie as rather narrow strips along the upper reaches of the drainage systems. At the heads of the draws the areas are generally wider or more expansive. The soil is widely distributed in a rather intricate pattern throughout the Decatur-Dewey-Emory soil association and parts of the Fullerton-Bolton-Clarksville association. It is one of the most extensive of the First-class soils.

The profile varies according to the length of time the soil material has lain in place. The areas that lie adjacent to drainageways generally consist of brown to dark-brown friable silt loam to a depth of 15 inches. Below this layer the color is lighter brown or light-reddish yellow with mottles of yellow and gray below depths of 30 to 45 inches, and the texture ranges from silt loam to silty clay loam. In areas where the soil material has lain in place for a relatively long time, the brown friable silt loam surface layer is about 12 inches deep. Below this and continuing to a depth of 20 inches is reddish-yellow or yellowish-brown moderately firm but friable silty clay loam. Next in profile is red firm but friable silty clay or silty clay loam. The depth to limestone bedrock normally ranges from 8 to 30 feet, although in a few places it is less than 8 feet.

This is one of the most fertile soils in the county and its organic-matter content is moderately high. Most of it is medium acid, but areas that receive water influenced by limestone may be slightly acid or neutral. Internal drainage is medium except in the wettest season.

Then the lower lying areas may have a temporary high water table. The soil is permeable to both roots and moisture throughout its depth. The rate of infiltration is a little slower on the older areas where the subsoil is a little firmer and more slowly permeable.

Use and management.—Practically all of this soil has been cleared and cropped. Crops requiring tillage occupy a large part of it. Corn, small grains, hay (chiefly lespedeza, red clover, and some alfalfa), tobacco, and vegetables are the chief crops. Row crops are grown on some areas for several years in succession, but on a great part a short rotation (2 to 3 years) is used. Some fertilization is practiced, and lime has been applied to much of the acreage. Yields are relatively high—corn about 50 bushels, wheat 18 bushels, and lespedeza 1½ tons.

The high fertility, smooth surface, and exceptionally favorable moisture relations make this one of the most desirable soils in the county. It is suited to intensive use, including production of many vegetables and tobacco. All common farm crops produce well, although there is some evidence that this soil is not so well suited to alfalfa as the undulating and rolling phases of the Decatur and Dewey series. Because the soil is less firm, a good stand of alfalfa is more difficult to maintain for a period of several years, and more frequent reseeding is therefore necessary. This soil responds to fertilization and generally to liming. Where productivity is maintained at a high level, yields of 70 bushels of corn, 28 bushels of wheat, and 3.7 tons of alfalfa can be expected. This soil produces luxuriant pasture for a great part of the growing season. The carrying capacity under favorable conditions is about 155 cow-acre-days.

Emory silt loam, rolling phase (5–12% slopes) (Eb).—This soil is widely distributed along drainageways and at stream heads in a rather intricate pattern throughout the Decatur-Dewey-Emory soil association and parts of the Fullerton-Bolton-Clarksville soil association. Most of the areas lie as narrow strips directly below higher lying Decatur, Dewey, Farragut, and Fullerton soils. Like the undulating phase, this is one of the more extensive of the First-class soils. It has stronger slopes than that phase, and in most areas it consists of older local alluvium and is therefore predominantly firmer in the subsoil and freer of the occasional mottling in the lower subsoil.

The surface layer of this rolling phase is 8 to 12 inches of brown friable silt loam. Below this is subsoil material consisting of reddish-yellow moderately firm but friable silty clay loam or silty clay. The depth to limestone bedrock normally ranges from 8 to 30 feet, although in a few places it is shallower.

This is one of the most fertile soils of the county. The organic-matter content is moderately high, and the reaction is medium acid. Internal drainage is medium. The soil is permeable to both moisture and plant roots, although infiltration of moisture is slightly retarded in places by the moderately firm subsoil.

Use and management.—Practically all of this soil has been cleared and cropped and a great part is used for crops requiring tillage. Corn, small grains, hay crops (lespedeza, red clover, alfalfa), tobacco, and vegetables are the chief crops grown. Pasture occupies a small acreage and is normally used as part of a relatively short rotation. Rotations commonly last 2 to 4 years. Corn and small grains ordinarily

receive light applications of fertilizer; tobacco and vegetables get moderately heavy applications of manure. Alfalfa commonly receives moderate applications of manure and mixed fertilizer and about 2 tons of lime when seeded. Under ordinary conditions crop yields are high. Corn yields about 47 bushels, oats 37 bushels, and tobacco 1,700 pounds an acre. Pastures are generally of good quality. They consist of bluegrass, lespedeza, orchard grass, and white clover, separately or mixed, and have a carrying capacity of about 125 cow-acre-days.

High fertility, smooth surface, and favorable moisture relations make this one of the most desirable soils in the county for the crops. It is suited to moderately short rotations (3 to 4 years). The slope, however, is strong enough that continuous use for row crops will reduce productivity. The soil responds to heavy fertilization. Where the content of organic matter and plant nutrients is maintained at a high level and other good management requirements are met, corn will yield 65 bushels, oats 57 bushels, and alfalfa 3.5 tons. As for the undulating phase of Emory silt loam, good stands of alfalfa are more difficult to maintain on this soil than on the more fertile well-drained soils with moderately firm subsoils.

The sloping surface of this rolling phase requires that some attention be given to runoff control. Winter cover crops and other close-growing crops are important in the rotations. Where feasible, tillage should be according to the contour. This soil is well suited to pasture. Where the more desirable grasses and legumes are adequately fertilized, pasture of high carrying capacity can be maintained. Favorable moisture relations make this soil suitable for grazing during drier periods of the grazing season.

Emory and Abernathy silt loams (0–5% slopes) (Ea).—The soils of this undifferentiated unit are derived from well-drained local alluvium in limestone sinks. The separate areas, ranging from less than an acre to 8 or 10 acres in size, are widely distributed throughout the Decatur-Dewey-Emory soil association and some parts of the Fullerton-Bolton-Clarksville association. The surface generally is saucer-like; a great part of the acreage is nearly level and consists of Abernathy silt loam, whereas the gently sloping outer parts consist of Emory silt loam.

The surface 12 inches of Abernathy silt loam is brown or reddish-brown friable silt loam. Underlying this is reddish-brown or yellowish-brown friable silt loam. Below a depth of 30 inches is mottled yellow and gray silt loam or silty clay loam. In places there is a 6- to 10-inch dark-brown silt loam layer at depths ranging from 12 to 28 inches. This layer, formerly a surface soil, has been covered in recent years by alluvium washed from soils on the adjacent upland. The parts of this undifferentiated unit that consist of Emory silt loam are similar to Emory silt loam, undulating phase.

Emory and Abernathy silt loams are very fertile and have a moderate to high content of organic matter. Most of the areas are slightly to medium acid. Internal drainage is moderate, and the entire profile of both soils is easily permeable to moisture and roots. The capacity for holding moisture available to plants is high.

Use and management.—Practically all areas are cleared and cropped. Corn, small grains, and hay predominate; some tobacco and vegetables are also grown. On some areas row crops are grown

for many years in succession, but on others they are grown in 2- to 3-year rotations. Not much fertilization is practiced except for tobacco and vegetables. Some of the acreage in corn and small grains is fertilized with 75 to 125 pounds of 20-percent phosphate or its equivalent, or with 0–10–4 or 2–10–2 mixed fertilizer. Vegetables commonly receive 500 to 1,000 pounds an acre of 2–12–6, 3–9–5, or 2–8–4 fertilizer. Crop yields are generally high: Corn averages 45 bushels, wheat 15 bushels, and alfalfa 3.3 tons. Lime has been applied to some areas.

These are among the most productive soils in the county. They are easily worked and conserved and are suited to a wide variety of crops, including alfalfa. Good stands of alfalfa are more difficult to maintain, however, than on some of the more fertile well-drained soils of the upland. These soils are suited to intensive row-crop production. Where adequately fertilized and given other good management, they will yield 65 bushels of corn, 4.0 tons of alfalfa, and about 2,000 pounds of tobacco an acre.

These soils are very productive of pasture, as moisture relations are exceptionally favorable. Temporary flooding is a hazard during heavy rains, since water from uplands is not removed fast enough through the subterranean outlets. The water may leave deposits of mud that greatly reduce grazing value until they are removed by later rains or until new vegetation develops. The degree of flooding depends on the area of upland that drains to the lime sinks and on the rate at which subterranean outlets remove the water. Pasture persists during dry periods much better than it does on the associated higher upland soils. Where fertility is kept high, pasture will have a carrying capacity of about 150 cow-acre-days.

Etowah silt loam, undulating phase (2–5% slopes) (Ed).—This is a brown well-drained soil on moderately high stream terraces. It consists of mixed alluvium that appears to be strongly influenced by limestone. Some areas are in the Cumberland-Huntington soil association on relatively broad smooth benches easily recognized as alluvial plains. Others occur along some of the larger creeks, chiefly Beaver and Big Flat Creeks, mainly on small terrace remnants not easily distinguished from the adjacent upland. Some tracts are scattered wherever remnants of old alluvial plains still exist. Some areas of this soil are associated with Sequoia, Farragut, and Litz soils.

Profile description:

0 to 7 inches, grayish-brown silt loam.
7 to 30 inches, yellowish-brown, with a reddish cast, friable silty clay loam or silty clay.
30 inches+, yellowish-brown, with a reddish cast, friable silty clay loam with faint gray mottlings; limestone or shale bedrock is at greatly variable depths, depending on the thickness of the stream-terrace deposit, but usually at 6 to 40 feet.

Those areas along the Tennessee and French Broad Rivers contain some mica flakes and in a few places some cobblestones. A gravelly layer is common at the base of the alluvium. Many areas along the creeks have soft weathered yellow, brown, and gray shale, identical to that of Sequoia soils, at depths of 30 to 48 inches.

Internal drainage is moderate and the soil is easily permeable to roots and moisture. Water infiltrates more easily than in soils of the

Decatur, Farragut, and Talbott series and other soils that have firmer subsoils. The capacity for holding moisture available to crops is high. Natural fertility is moderately high, and the organic-matter content is medium. The soil is medium acid.

Use and management.—Practically all of this soil is used for cultivated crops. Corn, small grains, grasses, and legumes, including alfalfa, are the most common crops. Some vegetables are grown. A common rotation is corn, 1 year; small grain, 1 year; redtop, timothy, and red clover or lespedeza, 1 or 2 years. Row crops are grown on some areas approximately every other year.

Under ordinary conditions corn yields 30 to 40 bushels, wheat 15 to 18 bushels, and alfalfa 2½ to 3½ tons an acre. Corn is rarely fertilized. Small grains receive from 100 to 150 pounds of 16-percent or 20-percent phosphate an acre. Most of this soil is treated with 1 to 2 tons of ground limestone an acre every 4 to 6 years. Alfalfa receives somewhat larger applications of lime and phosphate than small grains.

This First-class soil is productive, easily worked, and easily conserved. It is well suited to a wide variety of crops, including alfalfa. tobacco, and market vegetables. The soil responds well to fertilization and can be used intensively without especially exacting management. Where adequate fertilization, including applications of organic matter and lime, is practiced, 2- to 4-year rotations are feasible. Special attention should be given to runoff control on the more sloping parts. On the whole, however, water does not accumulate so rapidly as on the firmer more clayey soils. In places it may be feasible to practice contour cultivation and possibly to construct broad-base terraces. Such terraces, however, are not in common use. Where the fertility is kept at a high level and tilth is good, corn will yield 60 bushels, wheat 26 bushels, and alfalfa 3.8 tons an acre. Pastures of excellent quality are easily established where the fertility is high. Pasture consisting of bluegrass, orchard grass, Bermuda grass, and white clover has a carrying capacity of about 135 cow-acre-days.

Etowah silty clay loam, eroded undulating phase (2–5% slopes) (Eg).—This is one of the more extensive of the Etowah soils. It occupies areas, formerly of the (uneroded) undulating phase, that have been so eroded that subsoil material is within plow depth in more than half the area. Some areas are in the Cumberland-Huntington soil association. Others are along some of the larger creeks, chiefly Beaver and Big Flat Creeks. Yet other tracts are in various parts of the county where remnants of old alluvial plains still exist. The areas in the Cumberland-Huntington soil association are on relatively broad, smooth, easily recognized alluvial plains, whereas many of those along the creeks are on small terrace remnants that are not easily distinguished as alluvial plains. Some areas are associated with Sequoia, Farragut, and Litz soils.

The grayish-brown silty clay loam plow layer consists of a mixture of the original surface soil and subsoil material. Below this is brownish-yellow or yellowish-brown, with a reddish cast, friable silty clay loam that is faintly mottled with gray below 30 inches. Limestone or shale bedrock is at depths of 6 to 40 feet. In places the surface soil has not been so much eroded that the plow layer is silt loam rather

than silty clay loam. In some other patches where erosion has been exceptionally active, the subsoil is exposed and the plow layer is yellowish-brown silty clay loam or silty clay. Those areas along the Tennessee and French Broad Rivers have a notable amount of mica throughout the soil and in some places have cobblestones. A gravelly layer is in the lower part of the alluvium in places.

This phase has medium internal drainage and is easily permeable to roots and moisture. Percolation of water is fairly rapid. The capacity to hold moisture available to plants is high, although somewhat less than that of the undulating phase. Natural fertility and organic-matter content, also a little lower, are moderately high. The soil is medium acid.

Use and management.—All of this soil has been cleared and is now used chiefly for crops; a small part is in pasture. Corn, hay, and small grains are the chief crops. Tobacco and vegetables are important cash crops, although their acreage is not great. Red clover, lespedeza, alfalfa, timothy, and redtop are the main hay crops. Rotations last 2 to 4 years. Corn is not fertilized regularly. Small grains commonly are given 100 to 150 pounds of 20-percent phosphate an acre, or its equivalent. Most of this soil has been limed at the rate of 1 to 2 tons of ground limestone an acre once every 5 or 6 years. Alfalfa, tobacco, and vegetables are more heavily fertilized, and some manure is used when available. Under common management corn yields 30 bushels, oats 33 bushels, and tobacco 1,400 pounds.

This is a very desirable soil for crops and pasture, although it is a little less suitable than the undulating phase because of its moderate erosion. High fertility, smooth surface, good tilth, favorable moisture relations, and responsiveness to heavy fertilization make this a productive soil. It is easily worked and conserved and is suited both to a wide variety of crops and to intensive use. Rotations lasting 2 to 4 years should be used.

Tobacco yields well, as do potatoes and tomatoes, sweet corn, and other truck crops. High yields of the more desirable legume hay crops can be expected where adequate amendments, particularly lime and phosphorus, are used and good tilth is maintained. Pastures of excellent quality are easily established if properly fertilized, limed, and seeded. Clipping of weeds and excess vegetation may be necessary in places to maintain grazing of high quality. Under good management corn will yield 55 bushels, oats 55 bushels, alfalfa 3.6 tons, and tobacco 1,900 pounds an acre. Pasture of high quality has a carrying capacity of about 125 cow-acre-days. The favorable moisture relations make pasture on this soil somewhat less subject to drought than on many other soils such as the Talbott, Sequoia, and Dandridge.

Etowah silty clay loam, eroded rolling phase (5–12% slopes) (Ef).—This soil differs from the eroded undulating phase chiefly in slope. It occupies the more rolling parts of some of the stream terraces and is one of the more extensive of the Etowah soils. Much of it is in the Cumberland-Huntington soil association along the French Broad, Holston, and Tennessee Rivers. Other tracts are on stream terraces along the larger creeks, chiefly Beaver and Big Flat Creeks.

The plow layer is grayish-brown or yellowish-brown friable silty clay loam; the underlying layers are similar to those of the undulating

phases. In the less eroded patches, the texture is silt loam; in those most severely eroded, the plow layer consists chiefly of subsoil material and is firm yellowish-brown silty clay loam with a reddish tinge. The severely eroded areas are indicated on the map by erosion symbol. Areas of this soil along the French Broad and Tennessee Rivers contain mica flakes and in places they have cobbles or a layer of gravelly material in the lower part of the alluvium.

This is a fertile soil. It has good tilth and a moderate amount of organic matter except in the severely eroded parts. Internal drainage is medium, and the soil is permeable to roots and moisture. The reaction is medium acid. The capacity for holding moisture available to plants is high, although a little lower than that of the less eroded phases.

Use and management.—All of this soil has been cleared and cropped at some time. A great part is still used for crops, chiefly corn, hay, and small grains. Light fertilization is practiced for corn and small grains, and lime has been applied to much of the acreage. Alfalfa is fertilized fairly heavily with a phosphate fertilizer or a mixed fertilizer and limed at the time of seeding. Tobacco and vegetables receive moderately heavy applications of mixed fertilizer and some manure when available. Pastures have been limed in most places but are not commonly fertilized. Under ordinary conditions corn yields 28 bushels, lespedeza 1.0 ton, and tobacco 1,300 pounds an acre.

This is a productive soil suited to a wide variety of crops. Chiefly because of its rolling surface, its management requirements are more exacting than for the undulating phases of the Etowah series. This is particularly true for the severely eroded parts. For most areas of this soil, 4- or 5-year rotations are necessary if runoff is to be adequately controlled. In addition, tillage operations should be on the contour. Strip cropping and diversion of runoff by mechanical structures are feasible in places. Fall-sown small grains and legumes and grasses for hay and pasture can well make up the greater part of the rotation. Adequate fertilization, additions of organic matter, either by use of manure or legume green-manure crops, and liming are good management practices that will aid greatly in maintaining high productivity. Under good management corn can be expected to yield 50 to 55 bushels, oats about 50 bushels, and alfalfa about 3.3 tons an acre. This soil is capable of producing excellent pasture with a carrying capacity of about 120 cow-acre-days.

Etowah silty clay loam, eroded hilly phase (12–25% slopes) (Ee).—In this phase are hilly areas of Etowah soil that has been moderately eroded. The plow layer on much of the area is grayish-brown silty clay loam; it consists of original surface soil mixed with subsoil materials. The subsoil—yellowish-brown with a reddish cast—is friable silty clay loam or silty clay. Limestone or shale bedrock is at depths of 5 to 40 feet. In places, especially on the lower parts of slopes, residuum from these rocks is at the surface or at a shallow depth. The areas along the French Broad and Tennessee Rivers have mica throughout the soil; in some places there are cobbles, in others, a gravelly layer in the lower part of the alluvium. The degree of erosion varies. In patches less eroded than usual the surface soil is grayish-brown silt loam; in others all of the surface soil and part of

the subsoil have been lost and the plow layer is yellowish-brown firm silty clay.

Internal drainage is medium, and the soil is permeable to both roots and moisture. It has a fairly high capacity for holding moisture available to plants, and its natural fertility is moderately high. The reaction is medium acid.

Use and management.—All this soil has been cleared and used for crops. Much is now used for corn, hay, and small grains; most of the rest is pasture. Moderately long rotations are common. Corn and small grains generally are treated with 100 to 125 pounds an acre of 20-percent phosphate or a mixed fertilizer.

This soil is suited to tilled crops, but its strong slope requires that long rotations be used. Row crops should be grown at long intervals. Legumes and grasses for hay and pasture are particularly suited because they produce well on this soil under moderate fertilization and liming and keep tillage at a minimum. When cultivation is practiced, it should be done on the contour. Areas not required for tilled crops can well be left in permanent meadow and pasture for long periods. Under good management, wheat will yield 21 bushels, alfalfa 2.8 tons, and pasture 105 cow-acre-days of grazing.

Etowah silty clay loam, severely eroded hilly phase (12–25% slopes) (EH).—This soil consists of hilly areas of Etowah soil that have been severely eroded. The separate areas are small and widely distributed in the Cumberland-Huntington soil association. Most of them lie on strong slopes below areas of smoother Etowah soils. The plow layer consists of yellowish-brown friable silty clay loam. The subsoil is yellowish-brown, with a reddish cast, friable silty clay loam or silty clay.

Internal drainage is medium to slightly impaired. Natural fertility is medium, and the reaction is medium acid. Tilth of the surface layer is not very favorable. Runoff develops quickly during rains. The capacity of the soil to hold moisture available to crops is limited. Crops, and especially pasture, suffer during dry periods.

Use and management.—All of this soil has been cleared and cropped. Some is pastured, some is idle, and a small acreage is cropped. Yields are low. The strong slope, unfavorable tilth and moisture conditions, and impaired fertility cause the soil to be low in productivity and difficult to work and conserve. Where feasible, it is best to use the soil for permanent pasture. Lime, organic matter, fertilizer, and proper seeding are required for properly establishing a pasture. The more desirable grasses and legumes, such as white clover, bluegrass, and orchard grass, can usually be established. After a period of rebuilding, a pasture sod of these plants will have a carrying capacity of about 75 cow-acre-days.

Farragut silty clay loam, eroded undulating phase (2–5% slopes) (FC).—Like others of the Farragut series, this is a well-drained soil of the smooth uplands of the shale valleys (pl. 6, *A*). Soils of this series resemble the Decatur soils in the upper 25 inches but differ in being underlain by shale rather than limestone and in having much less depth to bedrock.

This phase is distributed over the central and western parts of the county. It occurs chiefly with the Sequoia soils in the Sequoia-Leadvale soil association. It consists of tracts, formerly Farragut silt

loam, undulating phase, that are now so eroded that subsoil material is within plow depth on more than half their extent. The plow layer is brown to light reddish-brown friable silty clay loam. The subsoil is reddish-brown firm silty clay. Soft shale is at depths of 18 to 50 inches. In a few patches all of the surface soil has been lost through erosion and the plow layer consists of reddish-brown firm silty clay subsoil material.

Included with this eroded undulating phase are about 89 acres that are not eroded. Here the surface soil is about 8 inches of brown friable silt loam. Because it is not eroded, the included soil is somewhat higher in natural fertility than the eroded undulating phase and has better tilth in the plow layer.

This soil is medium to strongly acid and has medium internal drainage. It is permeable to roots but notably less permeable to moisture than some of the more friable soils. Its capacity for holding moisture for crops is fairly good, although somewhat more limited than that of the less eroded undulating phase. During the drier parts of the growing season, crops will suffer from lack of moisture a little sooner on this soil than on such soils as Emory silt loam, undulating phase.

Use and management.—All of Farragut silty clay loam, eroded undulating phase, is cleared and used for corn, small grains, and lespedeza and other hay crops. A small acreage, most of which has been limed, is used for alfalfa, tobacco, and vegetables. Some manure is applied in places, especially for tobacco, vegetables, and alfalfa. A small quantity of fertilizer is used for other crops. Rotations lasting 2 to 4 years are in common use. Under ordinary conditions corn yields about 33 bushels, and alfalfa 2.9 tons. Pasture of good quality is easily maintained; it has a carrying capacity of about 85 cow-acre-days.

Although its natural fertility is a little lower and its tilth is less favorable than those for the included uneroded areas, this soil is productive and well suited to moderately intensive use. Rotations lasting 3 or 4 years that include corn, small grains, legume-and-grass hay, and pasture are suitable. Some care is required to restrain runoff. Where the general fertility and organic-matter content are kept at a high level, corn will yield 55 bushels, alfalfa 3.4 tons, and tobacco about 1,900 pounds an acre. White clover, bluegrass, Bermuda grass, orchard grass, lespedeza, and other pasture plants grow well. Well-managed pastures have a carrying capacity of about 125 cow-acre-days.

Farragut silty clay loam, eroded rolling phase (5–12% slopes) (FB).—This is one of the more extensive of the Farragut soils. It occurs in some of the shale valleys in the central part of the county and is associated with Sequoia soils and other Farragut soils in the Sequoia-Leadvale soil association. It differs from Farragut silty clay loam, eroded undulating phase, chiefly in having stronger slopes. The plow layer—a mixture of the original surface layer and some subsoil material—is brown to light reddish-brown silty clay loam. The few areas that have had little erosion have a 6- or 8-inch surface layer of brown friable silt loam. Where all of the original surface layer has been lost, the plow layer consists of reddish-brown silty clay subsoil material. The soil is underlain by soft shale at depths of 18 to 50 inches.

Internal drainage is medium. The soil is permeable to roots but its subsoil is rather slowly permeable to moisture. The capacity for

holding moisture available to crops is fairly good. Tilth is rather heavy; the plow layer puddles easily when moist and bakes or becomes hard when dry. The natural fertility is moderately high and the reaction is medium to strongly acid. The organic-matter content is moderate. Those areas that are least eroded are notably more friable and permeable and have a higher content of organic matter.

Use and management.—A great part of this soil has been cleared and is used for corn, small grains, and lespedeza and clover. Some alfalfa, tobacco, and vegetables are grown. Rotations lasting 3 and 4 years prevail. Lime has been applied to much of the acreage, and small amounts of fertilizer are commonly used. Under ordinary management corn yields about 28 bushels, oats 30 bushels, and alfalfa 2.6 tons an acre.

Moderately strong slopes make this soil rather poor for intensive cultivation. Moderately long rotation (4 to 5 years) are necessary to prevent erosion losses. Because it has relatively high natural fertility, the soil is productive of such general farm crops as small grains, clovers, and grasses. Its firm or heavy consistence and strong slopes make it less well suited to such row crops as tobacco. If organic matter, fertility, and generally good tilth are maintained and adequate lime is applied, corn will yield 50 to 55 bushels, oats 50 bushels, and alfalfa 3.2 tons an acre. This soil is well suited to pasture if high fertility is maintained. The more desirable grasses and clover have a carrying capacity of about 110 cow-acre-days.

Farragut silty clay loam, eroded hilly phase (12–25% slopes) (FA).—This is one of the less extensive of the Farragut soils; practically all of it occurs as relatively narrow strips on strong slopes below and adjacent to areas of smoother Farragut soils. Almost all of the soil has been eroded materially. In some places the plow layer is a brown to light reddish-brown silty clay loam resulting from mixture of the original surface soil with subsoil material. In other places it consists of reddish-brown firm silty clay subsoil. Soft shale bedrock is at depths of 12 to 50 inches.

The natural fertility is moderately high, but the organic-matter content is moderate to rather low. The quantity of organic-matter depends on how much original surface soil has been lost through erosion. The reaction is medium to strongly acid, and internal drainage is medium. The firm heavy subsoil is exposed in many places; it retards infiltration of moisture and makes tilth decidedly unfavorable on much of the acreage. The capacity for holding moisture available to plants is fair; it is limited by the clayey plow layer.

Use and management.—Practically all of this soil has been cleared and used for crops. Now much of it is used for pasture and about 25 percent is in crops. A small part is idle. Corn, small grains, and lespedeza are the chief crops. The quality of pasture varies greatly according to the management practiced and the degree of erosion. White clover and bluegrass are common in the better pastures. The poorer ones grow relatively low quality plants such as broomsedge and crabgrass. Little fertilization is practiced, and crop yields generally are not high.

Mainly because of the strong slope and heavy subsoil material in the plow layer, this soil is not well suited to tilled crops. Where conditions are at all favorable, the soil should be used for permanent

pasture. Phosphorus and lime are the chief requirements, but some fertilization with other plant nutrients and organic matter are useful in bringing the soil to high fertility. Under favorable conditions more desirable pasture plants such as white clover, bluegrass, orchard grass, and Bermuda grass produce high quality pasture with a carrying capacity of 100 cow-acre-days. The grazing season, however, is more limited than on some of the other soils with a higher capacity for holding moisture available to plants. Vegetation suffers relatively early during dry periods. Areas that must be used for crops will require long rotations, and particular care will be required to restrain runoff. Fall-sown small grains and legume-and-grass hay are among the better suited crops.

Fullerton silt loam, undulating phase (2–5% slopes) (Fx).—This is one of the less extensive of the Fullerton soils. Smooth moderately broad areas of it are widely distributed on ridge tops throughout the Fullerton-Bolton-Clarksville soil association. It is a gray to brownish-gray moderately cherty soil (pl. 6, *B*) with a light-red subsoil. It is common to the cherty ridges and was developed over cherty limestone, practically all of which is dolomitic.

Profile description:

0 to 10 inches, brownish-gray to very pale-brown (dry) silt loam with a few small chert fragments throughout.
10 to 20 inches, brownish-yellow to reddish-yellow friable silt loam to silty clay loam with a few small chert fragments throughout.
20 to 60 inches, reddish-yellow to yellowish-red firm but moderately friable cherty silty clay.
60 inches+, variegated or reticulated reddish-yellow and gray firm silty clay; moderately cherty dolomitic limestone is at depths of 20 to 40 feet.

The organic-matter content is low and the natural fertility is moderate to low. The reaction is moderately to strongly acid. Internal drainage is medium. The soil generally is permeable to both roots and moisture, although the subsoil material below the 20-inch depth is sufficiently firm to retard percolation of moisture somewhat. The capacity of the soil to hold moisture available to plants is moderate. The tilth is notably favorable, and the soil dries enough for cultivation fairly soon after rains.

Use and management.—Most of this soil is still under cut-over native forest consisting chiefly of oaks and some hickory and other deciduous trees. A few pines are intermixed.

Favorable tilth, moisture relations, and lay of the land help make this soil well suited to a wide variety of crops, including corn (pl. 7, *A*), small grains, tobacco, and truck crops. It is also well suited to legume hay and pasture crops where the fertility is brought to a high level. In its natural state, however, the soil cannot be expected to maintain a good stand of the more desirable legumes such as alfalfa and red clover. Organic matter, nitrogen phosphorus, and lime are the chief amendments needed, but if high fertility is to be maintained all plant nutrients must be added through commercial fertilizer or organic manures. Moderately short rotations can be used, although some care is required in places to control runoff. Contour tillage may help to restrain erosion on the more sloping parts.

Where high fertility is maintained, corn will yield 52 bushels, lespedeza 1.8 tons, and tobacco, 1,600 pounds an acre. Pastures of high quality are more difficult to maintain than on such soils as the Dewey,

Emory, and Decatur. Nevertheless, very good pasture with a carrying capacity of about 125 cow-acre-days can be produced under favorable conditions.

Fullerton silt loam, eroded undulating phase (2–5% slopes) (Fu).—Most of this soil lies in smooth moderately broad tracts on ridge tops and is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. It is somewhat less extensive than the undulating phase. It is made up of tracts of the undulating phase that have been so eroded that subsoil material is within plow depth on more than half of their extent. The plow layer is brownish-gray silt loam, and the subsoil is reddish-yellow firm but moderately friable cherty silty clay.

The soil is moderate in natural fertility. It is permeable both to roots and moisture, although the deep subsoil is somewhat slowly permeable to moisture. Its capacity for holding moisture available to plants is moderate.

Use and management.—All of this soil has been cleared and cropped at some time. A great part is now used for corn, small grains, hay, vegetables, and tobacco. Rotations lasting 2 to 4 years are commonly used. In these rotations corn and small grains receive from 75 to 125 pounds an acre of 20-percent phosphate, 0–10–4, or 2–10–2 fertilizer. Lime has been applied to much of the acreage. Where alfalfa is to be grown, some phosphorus and manure are usually applied. Tobacco and vegetables are generally fertilized with moderately heavy applications of manure and some mixed fertilizer such as 2–12–6, 3–9–5, or 4–12–4. The fertility in most places is not maintained at a high level. Under ordinary conditions corn yields about 25 bushels, wheat 12 bushels, and lespedeza 0.9 ton an acre.

Moderately low fertility and low content of organic matter are the chief limitations of this soil. Its favorable tilth, moisture relations, and lay of the land help to make it well suited to a wide variety of crops, including corn, small grains, tobacco, and truck crops. It is also productive of the more desirable legumes and grasses if its fertility is kept at a high level. Nevertheless, a good stand of these plants is more difficult to maintain than on some of the more productive soils, such as the Dewey, Decatur, and Emory.

This soil is suited to moderately short rotations, but some method of controlling runoff may be needed for the more sloping parts. Under good management, including adequate fertilization, corn will yield 50 bushels, alfalfa 2.8 tons, and tobacco 1,500 pounds an acre. Pastures of good quality have a carrying capacity of about 115 cow-acre-days.

Fullerton silt loam, rolling phase (5–12% slopes) (Fw).—Like the undulating phase, this soil occupies the tops of cherty ridges in the Fullerton-Bolton-Clarksville soil association. The surface layer is brownish-gray silt loam, 8 to 10 inches thick. The subsoil is brownish-yellow, grading to reddish-yellow, firm but moderately friable cherty silty clay. Cherty dolomitic limestone is at depths of 20 to 35 feet.

The natural fertility and supply of organic matter are moderate to low. The reaction is moderately to strongly acid. Internal drainage is medium. The soil generally is permeable to both roots and moisture, although the subsoil material below 20 inches is firm enough

to retard percolation of moisture. The capacity of the soil to hold moisture available to plants is moderate. Tilth is notably favorable. The soil is dry enough for cultivation a short time after rains.

Use and management.—Most of this soil is still under native forest consisting chiefly of oaks mixed with hickory and other deciduous hardwoods. There are a few pines.

Good tilth, favorable moisture relations, and suitable lay of the land favor use of this soil for a wide variety of crops, including corn, small grains, tobacco, and truck crops. The low fertility and low organic content limit natural productivity. There is enough slope to require erosion control. Proper management therefore includes use of moderately long rotations in which row crops are grown only once in about 4 years.

Where feasible, contour tillage and strip cropping are desirable practices for controlling runoff. Keeping a close-growing live plant cover on the soil through the winter as well as the growing season is an effective way of restraining runoff and preventing erosion.

The soil is well suited to legume hay and pasture crops where adequately fertilized. If it is not fertilized, the more exacting legumes such as alfalfa and red clover cannot be expected to maintain a good stand. Unless the fertility is brought to a high level, lespedeza, redtop, and orchard grass are among the more desirable hay and pasture plants. Organic matter, nitrogen, phosphorus, and lime are the chief requirements; but if high fertility is to be maintained, all of the plant nutrients must be added in substantial amounts. Boron applications will be necessary for alfalfa.

Under a high level of management corn will yield 48 bushels, wheat 21 bushels, and alfalfa about 2.9 tons an acre. Tobacco and many truck crops, including melons, produce well but require rather heavy fertilization for good yields. The carrying capacity of pasture is about 110 cow-acre-days.

Fullerton silt loam, eroded rolling phase (5–12% slopes) (FT).—This soil is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. It is one of the most extensive of the Fullerton series and occupies a great part of the tops of the cherty ridges. The separate areas range from 10 to 100 acres or more in size. The soil is made up of tracts, formerly of the rolling phase, that have been so eroded that the plow layer on more than half their extent is now a mixture of surface soil and subsoil material.

The plow layer is brownish-gray or yellowish-gray silt loam, and the lower layers are similiar to those of the rolling phase. The general fertility and physical conditions are also similar to those of the rolling phase, except that the surface layer is thinner and the content of organic matter and plant nutrients is a little lower.

Use and mangement.—All of this soil has been cleared and a great part is now in use for crops, chiefly corn, lespedeza, redtop, and small grains. Tobacco and vegetables are common in places, and a small acreage of alfalfa is grown. Moderately short rotations prevail. One of the more common consists of 1 year of corn, 1 year of small grain, and 1 or 2 years of lespedeza. Corn and small grains generally receive 75 to 125 pounds an acre of 20-percent phosphate, 0–10–4, or 2–10–2 fertilizer. Tobacco and vegetables receive relatively heavy applications of manure with 500 to 1,000 pounds an acre of a complete

fertilizer such as 2–12–6, 3–9–5, or 3–12–4. When alfalfa is being established, it is generally treated with some manure and 200 to 500 pounds an acre of a complete fertilizer. Ground limestone is applied at the rate of 2 to 4 tons an acre.

This soil is suited to crops requiring tillage as well as to pasture. Its requirements for good management are the same as those described for Fullerton silt loam, rolling phase.

Fullerton silty clay loam, severely eroded rolling phase (5–12% slopes) (Fz).—This phase consists of areas, formerly of the rolling phase, so eroded that practically all of the surface soil has been removed. The separate tracts are small and not great in total area. They are widely distributed throughout the Fullerton-Bolton-Clarksville soil association. The plow layer consists of reddish-yellow firm silty clay loam or silty clay, and the underlying layers are similar to those of the rolling phase. Limestone bedrock is at depths of 15 to 30 feet.

The natural fertility is low, the content or organic matter is very low, and the reaction is medium to strongly acid. The compact clayey plow layer causes poor tilth. The soil becomes hard when dry and plastic or easily puddled when wet. The amount of moisture held for plants is low and the soil is therefore droughty. Internal drainage is somewhat impaired. Infiltration of moisture is slow, although roots penetrate the soil without great difficulty.

Use and management.—All of this soil has been cleared and cropped but a great part is now idle or used as unimproved pasture. Much has a sparse cover of lespedeza with variable amounts of briers, sassafras, broomsedge, and other weedy and brushy growth. Corn, small grains, and lespedeza are grown irregularly on some of this soil. The areas lie idle for 4 or 5 years between croppings. A small part of this phase is cropped regularly along with associated less eroded Fullerton soils. Moderate amounts of lime have been applied to much of the acreage. Yields of all crops are low under common management.

Under proper management this soil is suited to crops requiring tillage; but because of its low fertility, poor tilth, and unfavorable moisture relations, it has low productivity and limited suitability. If a relatively high level of production is to be achieved and maintained, long rotations must be used and adequate fertilizer applied. The soil especially needs organic matter, and phosphorus and lime will be required. Fall-sown small grains and legumes and grasses for hay and pasture are among the better suited crops. Occasionally a row crop such as corn can be grown satisfactorily. Contour tillage and strip cropping aid in controlling runoff and erosion. Under a high level of management oats will yield 25 bushels, lespedeza 1 ton, and alfalfa 1.9 tons an acre. Where vegetation of high quality has been established, the carrying capacity of pasture is about 70 cow-acre-days. The droughtiness of this soil limits grazing during dry periods.

Fullerton silt loam, hilly phase (12–25% slopes) (Fv).—This is not one of the more extensive Fullerton soils; it represents, in general, only that part of hilly Fullerton silt loam that has not been cleared and cultivated. The separate areas are not large and they are widely distributed throughout the Fullerton-Bolton-Clarksville soil association. It is a gray to brownish-gray moderately cherty soil with a

light-red subsoil and is common to the cherty ridges. It is similar to the undulating phase of Fullerton silt loam but differs chiefly in having a stronger slope and generally a thinner surface soil. It has developed over cherty dolomitic limestone.

Profile description:

0 to 7 inches, gray to brownish-gray friable silt loam containing some small chert fragments.
7 to 18 inches, brownish-yellow friable silt loam grading with depth to silty clay loam and containing some small chert fragments.
18 to 50 inches, reddish-yellow firm but moderately friable cherty silty clay.
50 inches+, variegated or reticulated reddish-yellow and gray firm silty clay; moderately cherty dolomitic limestone at depths of 10 to 25 feet.

The organic-matter content and the natural fertility are low and the reaction is moderately to strongly acid. Internal drainage is medium The soil is permeable to both roots and moisture, although the subsoil below a depth of 18 inches is sufficiently firm to retard percolation of moisture somewhat. The capacity of the soil to hold moisture available to crops is moderate. The tilth is notably favorable, and the plow layer dries enough for cultivation rather soon after rains.

Use and management.—Practically all of this soil is under cut-over forest consisting chiefly of oaks with hickory and other deciduous trees intermixed. There are a few pines.

The soil is suited to crops requiring tillage but its strong slope and low fertility require proper management. Heavy fertilization is required for high productivity, and particular care is needed to restrain erosion. Long rotations consisting mainly of close-growing small grains and hay and pasture crops are therefore a part of good management. Although most legumes and grasses are suited, the more exacting ones, such as alfalfa, red clover, white clover, and bluegrass, are notably more difficult to maintain than on the more fertile Decatur, Dewey, and Farragut soils. Field operations are more difficult because of the strong slope and should be done on the contour to help check erosion. Under a high level of management, oats yield about 38 bushels, lespedeza 1.5 tons, and alfalfa 2.7 tons an acre.

Fullerton silt loam, eroded hilly phase (12–25% slopes) (Fs).—This is one of the most extensive of the Fullerton soils. The separate areas range from 15 to 200 acres in size and occupy an important part of the landscape throughout the Fullerton-Bolton-Clarksville soil association. The soil covers tracts, formerly of Fullerton silt loam, hilly phase, that have been so eroded that the subsoil is now within plow depth on more than half their extent. The plow layer accordingly consists of a mixture of the original surface soil and upper subsoil and is brownish-gray to brownish-yellow silt loam. The original surface soil on more exposed patches has been largely removed and the plow layer is reddish-yellow firm silty clay. Dolomitic limestone bedrock is at depths of 10 to 25 feet.

Use and management.—All this soil has been cleared and cultivated and at present is used for hay and pasture and to a less extent for corn and small grains. There is a very small acreage of tobacco and truck crops.

Under common management, yields are fair to low. Corn yields about 20 bushels, wheat 9 bushels, and lespedeza hay 0.7 ton an acre. The most common rotation is corn, 1 year; a small grain, 1 year; and lespedeza, 2 to 3 years. Permanent pastures consist chiefly of les-

pedeza, redtop, and some white clover and bluegrass, the last two usually on the most fertile soil. Much of this soil receives 2 to 3 tons of ground limestone an acre every 6 to 10 years. Corn and small grains commonly receive 75 to 125 pounds of 16- to 20-percent phosphate or 0–10–4 or 2–10–2 fertilizer. Alfalfa receives manure, 200 to 500 pounds of high grade complete fertilizer, and 2 to 4 tons of ground limestone an acre at seeding time. Pastures are generally limed, and some have received light applications of phosphate.

The suitability of this soil is similar to that of Fullerton silt loam, hilly phase, although its eroded condition lowers its productivity and, where the subsoil is exposed, makes the tilth less favorable. Crop yields under good management are slightly lower than for hilly phase.

Fullerton silty clay loam, severely eroded hilly phase (12–25% slopes) (FY).—Most areas of this soil are small. They range chiefly from 5 to 20 acres in size. They are on slopes of the cherty ridge lands and are widely distributed throughout the Fullerton-Bolton-Clarksville soil association. The soil covers areas, formerly of the hilly phase, that have lost practically all of the original surface soil through erosion. The plow layer is reddish-yellow firm silty clay loam or silty clay subsoil material. Dolomitic limestone bedrock is at depths of 10 to 25 feet. Small gullies are common in places but most of them can be crossed with farm machinery.

The natural fertility and content of organic matter are low; the reaction is medium to strongly acid. Tilth is unfavorable, and the capacity of the soil to hold moisture available to crops is low. Infiltration of moisture is slow but the soil is permeable to roots. Runoff increases quickly during rains.

Use and management.—All this soil has been cleared and cropped at some time. Much is now idle or used as unimproved permanent pasture. Corn, small grains, and lespedeza hay are grown to some extent. In places the soil lies idle for a period of years and then is cropped for a short time. Other parts are cropped more regularly along with associated areas of less eroded soils, chiefly those of the Fullerton series. A large part has been limed, but fertilization is not heavy and little organic matter is added. Under ordinary conditions corn yields are very low and lespedeza yields about 0.5 ton an acre. Pasture is of poor quality; its carrying capacity is about 30 cow-acre-days.

Poor tilth, low moisture-holding capacity, low fertility, and strong slope render this soil unfit for crops requiring tillage. However, it is capable of producing fair pasture if its fertility is increased to a relatively high level and a desirable pasture mixture is seeded. Droughtiness limits the grazing period, however, and the carrying capacity under a relatively high level of management is about 60 cow-acre-days. Such pasture plants as lespedeza, redtop, and orchard grass are more easily established than white clover, bluegrass, and alfalfa. It may be that these more exacting pasture plants can be maintained fairly well if adequate lime, fertilizer, and organic matter are included. Areas that must be used for crops require long rotations consisting chiefly of close-growing small grains, hay, and pasture crops.

Fullerton cherty silt loam, rolling phase (5–12% slopes) (FH).—This very cherty soil on the tops of the cherty ridges is widely distributed throughout the Fullerton-Bolton-Clarksville soil association.

The separate tracts range in size from 5 to 20 acres. It is one of the less extensive of the cherty Fullerton soils, as it represents approximately only those areas of cherty rolling Fullerton soil that are under native forest. It is underlain by dolomitic limestone at depths of 20 to 40 feet.

Profile description:

0 to 8 inches, gray or brownish-gray cherty silt loam.
8 to 24 inches, grayish-yellow, grading to reddish-yellow, friable cherty silty clay loam or cherty silt loam.
24 to 60 inches, reddish-yellow firm but brittle somewhat friable cherty silty clay.
60 inches +, variegated or reticulated reddish-yellow and gray firm cherty silty clay.

Generally there is enough chert to interfere materially with cultivation and in a few places enough to prohibit it. The chert fragments range from small to as much as 4 or 5 inches in diameter.

This soil is low in natural fertility and contains very little organic matter. The reaction is strongly acid. The entire soil is permeable to moisture and roots and its capacity for holding moisture available to plants is moderate.

Use and management.—This soil is practically all under native deciduous hardwood forest consisting chiefly of oaks and hickory. Its chertiness and relatively low fertility limit its usefulness for crops and pasture. Yields can be expected to be low. Workability is fair to poor. The soil is suited to fairly intensive use where adequately fertilized, but if moderately high yields are to be realized, heavy fertilization with all plant nutrients, lime, and organic matter is necessary. Most of the general farming crops, especially corn, small grains, and the less exacting legumes and grasses for hay and pasture are suited. Tobacco, potatoes, and other truck crops can be grown, but yields will be lower than on some of the more fertile soils and intensive cultivation will be more difficult because of the chert.

Under a high level of management corn can be expected to yield 45 bushels, oats 40 bushels, and lespedeza 1.5 tons an acre. Fairly good pastures can be maintained but the more exacting pasture plants, including white clover, red clover, and bluegrass, are more difficult to grow than lespedeza, orchard grass, and redtop. If good management is practiced, a carrying capacity of about 100 cow-acre-days can be maintained.

Fullerton cherty silt loam, eroded rolling phase (5–12% slopes) (FE).—Practically all of this soil is on the broader ridge tops. It is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. This phase differs from the rolling phase chiefly in having lost a notable part of its original surface layer through erosion. The subsoil for most of the acreage is within plow depth; consequently, the plow layer consists of a mixture of original surface soil and subsoil material.

Use and management.—All of this soil has been cleared and cropped at some time. A great part of the acreage is now in corn, small grains, and lespedeza. Some parts are used for pasture, and some vegetables and tobacco are grown. Regular rotations are not commonly practiced, but a row crop is grown every 2 or 3 years on much of the soil. Some fertilization is practiced, and lime has been applied to much of the acreage. Barnyard manure is not usually available in any great

quantity. Under ordinary conditions corn yields about 20 bushels, and lespedeza 0.7 ton. The carrying capacity for pasture is about 50 cow-acre-days.

Chertiness and low fertility limit the productivity and range of suitability of this soil. Such general farm crops as corn, small grains, and some of the legumes and grasses for hay and pasture are suitable. Tobacco and such truck crops as potatoes and tomatoes will yield fairly well if fertility is kept at a high level. Most of the acreage is suited to moderately short rotations, but on the more sloping parts particular care is required to restrain runoff. In these sloping places somewhat longer rotations are required and field operations carried out on the contour will aid in restraining runoff.

Where the fertility is kept relatively high, corn yields about 42 bushels, wheat 20 bushels, and lespedeza hay 1.4 tons an acre. Alfalfa and red clover can be grown, but good stands of these more exacting legumes are more difficult to maintain than those of lespedeza and redtop. Fairly good pastures can be maintained where the fertility is brought to a relatively high level. The chief fertilizer requirements are phosphorus, nitrogen, and lime. Bluegrass and white clover, however, are somewhat more difficult to maintain in pastures than lespedeza, redtop, and orchard grass. The average carrying capacity of permanent pasture is about 95 cow-acre-days.

Fullerton cherty silty clay loam, severely eroded rolling phase (5–12% slopes) (Fk).—The separate areas of this soil are small and widely distributed throughout the more cherty parts of the Fullerton-Bolton-Clarksville soil association. This phase is made up of areas formerly occupied by Fullerton cherty silt loam, rolling phase, that have lost practically all of the original surface soil through erosion. The plow layer now is reddish-yellow cherty silty clay loam or cherty silty clay. Below a depth of about 45 inches is variegated or reticulated reddish-yellow and gray firm brittle cherty silty clay. Dolomitic limestone bedrock is at depths of 10 to 25 feet.

The natural fertility is low, the organic-matter content very low, and the reaction strongly acid. The high content of chert and the clayey plow layer make the soil difficult to work. The plow layer is hard when dry and plastic or easily puddled when wet. The low amount of moisture available to plants causes the soil to be droughty. Internal drainage is somewhat impaired and infiltration of moisture is slow, although roots penetrate the soil without great difficulty.

Use and management.—All of the soil has been cleared and cropped but a great part is now idle or used as unimproved pasture. Much of it is sparsely covered with lespedeza and variable amounts of briers, sassafras, broomsedge, and other weedy and brushy growth. Little is used for crops.

Under a high level of management that includes adequate fertilization, liming, and addition of organic matter, this soil is fairly well suited to pasture and to crops requiring tillage. Because of the low fertility, poor tilth, and unfavorable moisture relations, however, it is low in productivity and difficult to work and to conserve. Small grains, hay, and pasture are among the better suited crops. Where good management is practiced, oats can be expected to yield about 22 bushels and lespedeza 0.8 ton an acre.

Fullerton cherty silt loam, hilly phase (12–25% slopes) (FG).—This soil differs from the rolling phase chiefly in having stronger slopes. Most of it is on the slopes of cherty ridges and widely distributed throughout the Fullerton-Bolton-Clarksville soil association. The separate tracts of this moderately extensive member of the Fullerton series range from approximately 15 to 80 acres in size.

The surface 7 or 8 inches is gray or brownish-gray cherty silt loam. Under this is grayish-yellow, grading to reddish-yellow, friable cherty silty clay loam or cherty silt loam. Below 24 inches is reddish-yellow firm but brittle somewhat friable cherty silty clay. This material is variegated or reticulated with red, yellow, and gray below a depth of about 48 inches. Dolomitic limestone bedrock is at depths of 10 to 25 feet.

Generally chert fragments up to 4 or 5 inches in diameter are sufficiently numerous to interfere materially with cultivation. In some parts they are so abundant that cultivation is practically prohibited. This soil is low in natural fertility and contains little organic matter. The reaction is strongly acid. The entire soil is permeable to moisture and roots and its capacity for holding moisture for plants is moderate.

Use and management.—Little of this soil has been cleared; practically all of it is under cut-over forest. Chiefly because of its chertiness and low fertility, the soil is not considered well suited to crops. It is capable of producing some pasture. Where the soil is properly limed, fertilized, and seeded, such pasture plants as lespedeza, orchard grass, and redtop will have a carrying capacity of about 90 cow-acre-days.

Fullerton cherty silt loam, eroded hilly phase (12–25% slopes) (FD).—This is one of the more extensive Fullerton soils and is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. The separate areas range from 20 to 200 or 300 acres in size. This phase consists of tracts that were formerly Fullerton cherty silt loam, hilly phase, which are now so eroded that the subsoil is within plow depth on more than half their extent. The plow layer accordingly consists of a mixture of the original surface soil and upper subsoil and is brownish-gray to brownish-yellow cherty silt loam. On the more exposed patches where the original surface soil has been largely removed, the plow layer is reddish-yellow firm silty clay. Dolomitic limestone bedrock is at depths of 10 to 25 feet.

Use and management.—All this soil has been cleared and cultivated at some time. A large part is now idle (pl. 7, *B*) or used as unimproved permanent pasture. The largest acreage is used for lespedeza, redtop, and orchard grass hay; a small part is in corn, small grains, and vegetables. Fertilization is light and little barnyard manure is available. A notable acreage has been treated with 2 or 3 tons of ground limestone an acre. Some of the corn receives approximately 75 to 125 pounds an acre of 20-percent phosphate, 0–10–4, ar 2–10–2 fertilizer. Tobacco and vegetables receive moderately heavy fertilization. Crop yields are usually low. Corn yields about 18 bushels and lespedeza 0.6 ton an acre.

Low fertility, chertiness, and strong slope make this soil poorly suited to crops requiring tillage. If well fertilized, limed, properly seeded, and protected against weedy and brushy growth, it will produce about 85 cow-acre-days of grazing. Areas required for crops

will support only long rotations that include close-growing small grains and hay and pasture crops. Such hay and pasture crops as lespedeza, orchard grass, and redtop are among the more easily established legumes and grasses. Where a relatively high level of fertility is maintained, oats will yield about 30 bushels and lespedeza 1.3 tons an acre.

Fullerton cherty silty clay loam, severely eroded hilly phase (12–25% slopes) (FJ).—This soil consists of areas, formerly of the hilly phase, that have now lost practically all the original surface soil through erosion. It is not extensive and most areas are small, or from 5 to 20 acres in size. They occur on the slopes of the cherty ridges and are widely distributed throughout the Fullerton-Bolton-Clarksville soil association. The plow layer consists of reddish-yellow firm cherty silty clay loam or cherty silty clay subsoil material. Dolomitic limestone bedrock is at depths of 10 to 25 feet. Small gullies are common but most of them can be crossed with farm machinery. The more severely gullied parts are represented on the soil map by appropriate symbol.

The natural fertility and content of organic matter are very low and the reaction generally is strongly acid. The plow layer has unfavorable tilth and is hard when dry and rather plastic when wet. The soil has low capacity for holding moisture available to crops and slow moisture infiltration. Nevertheless, it is fairly permeable to roots. Runoff increases quickly during rains.

Use and management.—All this soil has been cleared and cropped at some time. Much is now idle or in unimproved pasture. A small part is used for lespedeza hay, and a very small acreage for corn and small grains. Little fertilization is practiced and yields generally are very low.

Poor tilth, low moisture-holding capacity, low fertility, chertiness, and strong slope make this soil poorly suited to crops requiring tillage. It is capable of producing fair pasture where the fertility is increased to a relatively high level and a suitable pasture mixture is seeded. Droughtiness, however, greatly limits the grazing period. The carrying capacity, even under a high level of management, will not exceed 55 cow-acre-days. The more exacting pasture plants, such as white clover, red clover, and alfalfa, cannot be expected to develop a good cover except under especially good management. Areas that must be used for crops will not give high yields. Most suitable are small grains and hay and pasture.

Fullerton cherty silt loam, steep phase (25+% slopes) (FI).—This soil covers all Fullerton areas that have a steep slope and are not eroded. It is widely distributed in the more hilly parts of the Fullerton-Bolton-Clarksville soil association, generally along the northwestern half. It has a grayish cherty silt loam surface layer about 4 inches thick, below which lies yellow or reddish-yellow friable silty clay loam containing much chert. Underlying this and extending to a depth of about 40 inches is reddish-yellow cherty silty clay. Dolomitic limestone bedrock is at depths of 5 to 25 feet. The chert fragments reach a maximum of 8 or 10 inches in diameter. A few bedrock outcrops of cherty limestone are present.

The soil material is strongly acid and low in fertility and organic matter. It is permeable to roots and moisture and its water-holding capacity is fair to moderate.

Use and management.—Practically all of this soil is under cut-over forest consisting of deciduous hardwoods, chiefly oaks but with hickory, yellow-poplar, and beech intermixed (pl. 8, *A*). There are a few pines. Chiefly because of its low fertility, very strong slope, and chertiness, this soil is poorly suited to crops or pasture. Where feasible it should be used for forest. Shortleaf and loblolly pines are among the trees better suited to reforestation. Some areas may be required for pasture. If fair grazing is to be obtained, rather heavy fertilization, adequate liming, and proper seeding will be required. Under this management it may be possible to obtain approximately 75 cow-acre-days of grazing.

Fullerton cherty silt loam, eroded steep phase (25+% slopes) (FF).—This soil is widely distributed throughout the more strongly sloping parts of the Fullerton-Bolton-Clarksville soil association. The separate tracts reach a maximum of about 200 acres in size. The soil consists of cleared and plowed areas of the steep phase that have lost a notable part of the original surface layer through erosion. The plow layer now consists of a mixture of original surface soil and subsoil material; it is a brownish-yellow cherty silt loam. Below the plow layer is reddish-yellow cherty silty clay. Dolomitic limestone bedrock is at depths of 5 to 25 feet. The chert fragments range up to 10 inches in diameter and there are a few bedrock outcrops.

The soil is low in fertility and organic matter and strongly acid. It is permeable to roots and moisture and its capacity for holding moisture for plants is fair to moderate. Internal drainage is medium.

Use and management.—All of this soil has been cleared and cropped at some time but little is now used for crops. A notable part, however, is used for pasture and some is idle. Pastures are of fair quality, although parts are poor. The pastures consist mainly of lespedeza and broomsedge. This soil receives little fertilizer and lime. Its carrying capacity is usually low.

Low fertility, extreme chertiness, and strong slope make this soil poorly suited to crops or pasture. Under most conditions it is best suited to forest, probably of shortleaf and loblolly pine. Areas that must be used for pasture require heavy fertilization and liming as well as proper seeding if good grazing is to be had. Under the most favorable conditions pasture has a carrying capacity of about 70 cow-acre-days.

Fullerton cherty silty clay loam, severely eroded steep phase (25+% slopes) (FL).—Separate areas of this soil are not large and are widely distributed throughout the more hilly parts of the Fullerton-Bolton-Clarksville soil association. The soil consists of tracts, formerly of the steep phase, from which erosion has removed practically all of the surface layer and in places part of the subsoil. To a depth of about 24 inches the material is reddish-yellow firm cherty silty clay. Limestone bedrock is at depths of 5 to 25 feet. Gullies occur in places but most of them can be crossed with farm machinery.

The more severely gullied parts are represented on the soil map by appropriate symbol. The chert fragments range up to 10 inches in diameter. Cherty limestone outcrops occur in a few places.

This soil is very low in fertility and organic matter and is strongly acid. Internal drainage is somewhat impaired and infiltration of moisture is rather slow. In consequence, runoff develops quickly during rains.

Use and management.—This soil has been cleared and cropped at some time. Much of it is now idle, or in unimproved permanent pasture that has little value. A great part supports a predominantly brushy growth consisting of sassafras, briers,and broomsedge.

Low fertility, steep slope, large quantity of chert, and unfavorable tilth make this soil poorly suited to crops or pasture. It should be reforested where at all feasible; loblolly pines are among the trees most suitable.

Fullerton loam, undulating phase (2–5% slopes) (Fr).—This soil occurs on some of the broader tops of the cherty ridges. It differs from Fullerton silt loam, undulating phase, chiefly in having an appreciable amount of sand throughout the soil. It is one of the less extensive of the Fullerton soils, as it represents only those undulating parts of Fullerton loam that have not been materially eroded. The separate areas are not large and are widely distributed throughout the Fullerton-Bolton-Clarksville soil association.

Profile description:

0 to 8 inches, brownish-gray loam.
8 to 20 inches, brownish-yellow friable loam, grading to sandy clay loam.
20 to 60 inches, reddish-yellow firm but moderately friable cherty silty clay loam or cherty silty clay.
60 inches+, variegated or reticulated reddish-yellow and gray firm clay loam; cherty sandy dolomitic limestone at depths of 20 to 40 feet.

Brown sandstonelike fragments are common throughout the entire depth of this soil and reach a maximum of about 4 inches in diameter. A small amount of chert also occurs throughout the profile. Neither the sandstonelike fragments nor the pieces of chert are numerous enough to interfere materially with cultivation.

The organic-matter content is low and the natural fertility moderate to low. The reaction is moderately to strongly acid. Internal drainage is medium. The soil generally is permeable to both roots and moisture, although the subsoil material below 20 inches is firm enough to retard percolation of moisture somewhat. The capacity of the soil to hold moisture available to plants is moderate. Tilth is notably favorable and the soil becomes dry enough for cultivation soon after rains.

Use and management.—Practically all of this soil is still under cutover native forest, chiefly of oaks, but some hickory and other deciduous trees are intermixed. There are a few pines.

The favorable tilth, moisture relations, and relief help make this soil well suited to a wide variety of crops, including corn, small grains, tobacco, and truck crops. Its loamy nature should make it favorable for cultivation early in spring. It is also well suited to legumes for hay and pasture. Nevertheless, the more exacting legumes and grasses, such as bluegrass, alfalfa, and red clover, are not so well suited to this soil as to the more fertile soils such as the Dewey and Decatur.

The relatively low fertility requires moderately heavy fertilization for fairly good yields. Organic matter, nitrogen, phosphorus, and lime are among the chief fertilizer requirements, but if high fertility is to be maintained, practically all plant nutrients must be added. Moderately short rotations can be used, but some care is required on the more sloping parts to control runoff properly. Contour tillage may aid in controlling erosion on the stronger slopes. Where high fertility is maintained corn will yield about 52 bushels, oats 46 bushels, and lespedeza 1.8 tons an acre. Tobacco, if properly fertilized, yields about 1,600 pounds an acre and is of good quality. Where good pasture is maintained, the carrying capacity is about 125 cow-acre-days.

Fullerton loam, eroded undulating phase (2–5% slopes) (Fo).—Most of this soil lies in smooth moderately broad areas on ridge tops. It is widely distributed throughout the Fullerton-Bolton-Clarksville soil association and consists of tracts formerly of Fullerton loam, undulating phase, that are now so eroded that subsoil material is within plow depth on more than half their extent. The plow layer is brownish-gray loam. The subsoil is reddish-yellow firm but moderately friable or cherty silty clay. Dolomitic limestone bedrock is at depths of 20 to 40 feet.

The natural fertility is moderately low and the reaction medium to strongly acid. Internal drainage is medium. All of the soil is permeable to both roots and moisture, although the subsoil material is somewhat more permeable to moisture than the rest. The capacity of the soil to hold moisture available to plants is moderate.

Use and management.—This soil has been cleared and a great part is now used for crops. Corn, small grain, hay (chiefly lespedeza and redtop), and vegetables are the chief crops grown. Some tobacco also is grown. Corn and small grains commonly receive 75 to 125 pounds an acre of phosphate or 0–10–4 fertilizer. Little manure is available for these crops. Vegetables and tobacco receive some manure and 500 to 1,000 pounds an acre of high grade fertilizer. Moderately short rotations are used. One of the most common is corn, 1 year; a small grain, 1 year; and then lespedeza and grass, 1 to 3 years. Under ordinary conditions corn yields about 25 bushels, wheat 12 bushels, and lespedeza hay 0.9 ton an acre.

This soil is considered well suited to crops requiring tillage. Although its natural fertility is not high, it is easily worked and conserved. It is suited to moderately short rotations of a wide variety of crops, particularly vegetables. For general form crops, phosphorus, lime, nitrogen, and organic matter are needed. The soil is not so well suited to the more exacting hay and pasture crops as some of the more fertile soils. Where its fertility is kept relatively high, however, the carrying capacity is about 110 cow-acre-days. Under good management corn will yield about 50 bushels and lespedeza 1.6 tons an acre.

Fullerton loam, rolling phase (5–12% slopes) (Fq).—This soil differs from the undulating phase in having a stronger slope. The surface 8 inches, a brownish-gray loam, is underlain by brownish-yellow friable clay loam or cherty silty clay. Below a depth of about 20 inches is reddish-yellow firm but moderately friable clay loam or cherty silty clay. Below 60 inches is firm clay loam variegated and

reticulated with red, yellow, and gray. Dolomitic limestone bedrock is at depths of 20 to 40 feet. A variable content of brownish sandstonelike fragments interferes with cultivation.

The natural fertility and organic-matter content are low. The reaction is moderately to strongly acid. Internal drainage is medium. The soil generally is permeable to both roots and moisture, although the subsoil material below 20 inches is firm enough to retard percolation of moisture somewhat. The capacity of the soil to hold moisture for plants is moderate. The tilth is notably favorable and the soil dries rapidly after rains. Most of this soil is still under cut-over native forests of oaks and hickory, with other deciduous trees and a few pines intermixed.

Use and management.—This soil is well suited to crops requiring tillage, although its natural fertility is moderately low and its slope steep enough to cause runoff when the soil is cultivated. It is well suited to many kinds of crops, including corn, small grains, tobacco, and market vegetables. It is also suited to legumes and other hay and pasture crops if the fertility is brought to a high level. It is not so well suited to the more exacting legumes, such as alfalfa and red clover, as some of the more fertile soils.

Organic matter, nitrogen, phosphorus, and lime are the chief requirements, but if high fertility is to be maintained, all of the plant nutrients must be added. Moderately short rotations can be used, although some care is required to control runoff on the more sloping parts. Where high fertility is maintained, corn will yield about 48 bushels, oats 43 bushels, and lespedeza 1.6 bushels. Good quality tobacco yielding about 1,500 pounds an acre can be grown. The carrying capacity for pasture is about 125 cow-acre-days if it is properly fertilized, limed, and a suitable pasture mixture is seeded on a properly prepared seedbed. Some effort is required to suppress brushy and weedy growth.

Fullerton loam, eroded rolling phase (5–12% slopes) (FN).—This fairly extensive soil occupies parts of the relatively broad tops of the cherty ridges. It is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. It consists of tracts of the rolling phase that have lost a notable part of the original surface soil through erosion. On more than half their extent, these areas now have a plow layer consisting of surface soil mixed with subsoil material. The plow layer is brownish-gray or yellowish-gray loam. The lower layers are similar to those of the rolling phase. Dolomitic limestone bedrock is at depths of 20 to 40 feet.

The general fertility and physical conditions are similar to those of the rolling phase except that the surface layer is thinner and has a lower content of organic matter and plant nutrients.

Use and management.—This soil has been cleared and a great part is now used for crops, chiefly corn, small grains, and lespedeza and redtop for hay and pasture. Tobacco and truck crops are also grown to some extent. Moderately short rotations are used, and a small amount of fertilizer is applied for most crops. Corn and small grains commonly receive 75 to 125 pounds an acre of 20-percent phosphate or 0–10–4 fertilizer. Vegetables and tobacco commonly receive some manure and from 500 to 1,000 pounds an acre of high grade fertilizer.

Under ordinary conditions corn yields about 23 bushels, wheat 11 bushels, and lespedeza 0.8 ton an acre.

This soil is well suited to a wide variety of crops, although its moderately low fertility necessitates heavy fertilization to maintain high productivity. Where adequate fertilization is practiced, rotations of moderate length are feasible and the soil is productive of such special crops as vegetables and tobacco. Its loamy nature makes it especially favorable for early crops. The rolling surface causes some runoff, but where feasible, contour tillage will aid in its control. The more exacting legumes and grasses, such as alfalfa, red clover, and bluegrass, are not so well suited as to some of the more fertile soils such as the Cumberland, Dewey, and Farragut. Where particular care is taken to maintain the fertility, however, yields of 2.6 tons of alfalfa an acre can be expected. Under good management corn will yield about 45 bushels, oats 40 bushels, and tobacco 1,400 pounds.

Fullerton loam, hilly phase (12–25% slopes) (Fp).—This soil is widely distributed throughout the more hilly parts of the Fullerton-Bolton-Clarksville soil association. The separate tracts range from about 15 to 80 acres in size. The soil is gray to brownish-gray and somewhat cherty. It has the light-red subsoil common to the cherty ridges. It differs from the undulating phase chiefly in having a stronger slope and somewhat lower average depth to bedrock. In most places bedrock is at depths of more than 10 feet.

The natural fertility is moderately low and the reaction is moderately to strongly acid. Internal drainage is medium and the soil generally is permeable to both roots and moisture. Nevertheless, the subsoil below a depth of 18 inches is sufficiently firm to retard percolation of moisture somewhat. The capacity of the soil to hold moisture available to plants is moderate. Tilth is notably favorable, and the plow layer dries quickly after rains.

Use and management.—Practically all of this soil is under native forest, chiefly oaks and hickory with some other deciduous trees and a few pines intermixed. It is suited to crops, although hilliness makes it somewhat difficult to work and conserve. The moderately low fertility necessitates heavy fertilization if high yields are to be obtained. Long rotations consisting chiefly of close-growing small grains and hay and pasture crops are suited. Row crops generally should not be grown, and if they are, at infrequent intervals. Where feasible, much of the acreage can well be used for hay and pasture for long periods. Lespedeza, redtop, and orchard grass are well suited, and if fertility is kept high, the more exacting legumes and grasses can be grown. Where cultivation is required, tillage on the contour will help restrain runoff. Strip cropping may also be practical on long slopes. If the fertility is kept at a high level, lespedeza will yield about 1.5 tons and oats 38 bushels an acre. The carrying capacity of good pasture is about 90 cow-acre-days.

Fullerton loam, eroded hilly phase (12–25% slopes) (Fm).—This is one of the more extensive Fullerton soils. It is widely distributed throughout the Fullerton-Bolton-Clarksville soil association. Some tracts are as large as 200 acres. This phase consists of former areas of the hilly phase that have been so much eroded that

the plow layer on more than half their extent now consists of original surface soil mixed with subsoil material. In general, the soil is yellowish-gray loam underlain by reddish-yellow firm but moderately friable clay loam to cherty silty clay. Dolomitic limestone bedrock is at depths of 10 to 25 feet.

Use and management.—All of this soil has been cleared and cultivated. It is now used for corn, small grains, and lespedeza and grasses for hay and pasture. The acreage of pasture exceeds that of crops. Lespedeza, redtop, and broomsedge are the chief pasture plants and their carrying capacity under ordinary conditions is about 40 cow-acre-days. Most of this pasture has had some lime but little fertilizer or organic matter. Other crops receive light applications of commercial fertilizer but not much manure. Yields under ordinary conditions are about 20 bushels of corn, 20 bushels of oats, and 0.7 ton of lespedeza an acre.

In suitability this soil is similar to the hilly phase. Because of erosion it has a little lower productivity and, in the few places where the subsoil is exposed, less favorable tilth. Crop yields under good management will be slightly lower than on the hilly phase.

Greendale silt loam, undulating phase (2–5% slopes) (GD).—This is a gray to brownish-gray soil consisting of colluvium and alluvium washed chiefly from soils underlain by cherty dolomitic limestone, mainly the Fullerton and Clarksville. It occurs in small to moderate areas on the slopes below more strongly sloping Fullerton and Clarksville soils and along the drainageways and in the shallow saucerlike depressions and sinkholes associated with those soils. It is widely distributed throughout the cherty ridge sections of the county, which correspond to areas occupied by the Fullerton-Bolton-Clarksville soil association.

This soil varies somewhat in color and consistence of the subsoil. The higher lying parts have a heavier more yellowish-brown subsoil, and the lower lying parts a more friable permeable lighter colored subsoil. The following is a profile description of the higher lying parts:

0 to 10 inches, brownish-gray to light yellowish-brown mellow silt loam containing some gritty material and gravel.
10 to 30 inches, brownish-yellow firm but friable silty clay loam.
30 to 45 inches, pale yellow, mottled with gray, friable silty clay loam; brittle or moderately compact.

The following is a profile description of the lower lying parts:

0 to 10 inches, gray or brownish-gray mellow silt loam containing some gritty material and chert fragments.
10 to 20 inches, grayish-yellow silt loam or silty clay loam containing some gritty material and chert gravel.
20 to 40 inches, light brownish-yellow material weakly mottled or streaked with brown and gray.

Cherty dolomitic limestone bedrock is at widely variable depths, but in most places is at 8 to 25 feet. The natural fertility and content of organic matter are moderate to low. The reaction is medium acid. In most places internal drainage is medium but in a few it is somewhat retarded. The soil is permeable to both roots and moisture and its capacity to hold moisture for plants is moderately high.

Use and management.—Practically all of this soil has been cleared and a great part is used for crops, chiefly corn, small grains, lespedeza

and redtop hay, tobacco (pl. 8, *B*), and vegetables. Relatively short irregular rotations are used. In places row crops are grown several years in succession. Manure or winter cover crops are seldom used, except on a small acreage. Light applications of fertilizer are common. Corn and small grains are generally treated with 75 to 125 pounds of 20-percent phosphate fertilizer or 0–10–4. Vegetables and tobacco receive heavier applications, ranging from 300 to 500 pounds an acre of 2–10–2, 2–10–4, or 3–8–5. Much of this soil has been treated with 2 to 3 tons of ground limestone an acre; these applications are repeated every 6 to 8 years. Under ordinary conditions corn yields about 32 bushels, wheat 15 bushels, and lespedeza 1.2 tons an acre.

Pasture is usually of only fair quality; the more desirable legumes and grasses are not so common as on some of the more fertile soils, such as the Dewey, Emory, and Lindside. Under ordinary conditions pasture has a carrying capacity of about 95 cow-acre-days.

Although the natural fertility is not high, the favorable relief and good moisture relations of this soil make it well suited to relatively intensive use and to a wide variety of crops, provided good management is practiced. It responds well to proper fertilization and additions of organic matter and is not difficult to conserve against losses caused by runoff or leaching. Good tilth is easily maintained. Rotations lasting 2 or 3 years are suitable if fertility is kept high. Much of the acreage is desirable for vegetables and tobacco. Good stands of the more exacting legumes and grasses are more difficult to maintain than on some of the more fertile soils but can be had by supplying lime, nitrogen, and phosphorus. Alfalfa stands may be difficult to maintain longer than 1 or 2 years, and in most places boron will be required. Under good management corn will yield 55 bushels an acre, wheat 24 bushels, alfalfa 3.2 tons, and pasture 145 cow-acre-days of grazing.

Greendale silt loam, rolling phase (5–12% slopes) (Gc).—This soil occupies gentle foot slopes, alluvial fans, and strips along the upper reaches of the drainageways in the Fullerton-Bolton-Clarksville soil association. It differs from the undulating phase chiefly in having a stronger slope. In most places the soil has the more yellowish firmer subsoil described for the higher lying parts of the undulating phase. In places erosion has removed some of the original surface layer and the plow layer may consist of a mixture of the surface soil and subsoil materials. In these places the plow layer is light brownish-yellow silt loam or silty clay loam.

Use and management.—Practically all of this soil has been cleared and is now used for crops and pasture. The chief crops are corn, small grains, lespedeza, and redtop hay. Some acreage is used for tobacco and vegetables. The soil is managed like the undulating phase except that row crops are grown a little less frequently and the acreage in vegetables and tobacco is less. Yields in general are a little lower.

This soil is suited to crops requiring tillage but especially intensive use requires good management, chiefly because of the strong slope. Rotations lasting 3 and 4 years are suited. Some care is required to control runoff; at least tillage should be according to the contour and a close-growing cover of live plants should be maintained as much of the time as feasible. Where row crops are grown, they should be followed by legume winter cover crops to help control erosion and maintain fertility.

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The soil is suited to truck crops and tobacco, but greater care is required to maintain productivity where these crops are grown. Legumes and grasses for hay and pasture are suited. If good stands of the more exacting legumes and grasses are to be maintained, however, relatively heavy fertilization must be practiced. Where good management is practiced, corn yields about 50 bushels, wheat about 22 bushels, and alfalfa about 2.9 tons an acre.

Greendale cherty silt loam, undulating phase (2–5% slopes) (GB).—This very cherty soil consists of colluvium and local alluvium washed from soils (mainly Clarksville and Fullerton) underlain by cherty dolomitic limestone. It differs from the undulating phase of Greendale silt loam chiefly in having enough chert throughout its entire depth to interfere materially with tillage. In addition, this soil is less extensive and is not so widely distributed throughout the cherty ridge lands. It is more commonly associated with Clarksville than with Fullerton soils.

Profile description:

0 to 10 inches, gray or brownish-gray silt loam containing much coarse gritty material and chert fragments, some as much as 6 inches in diameter.
10 to 20 inches, gray to yellowish-gray silt loam or silty clay loam containing much gritty material and many chert fragments.
20 to 40 inches, light brownish-yellow or grayish-yellow silty clay loam mottled with light-brown or light shades of gray; contains variable amounts of grit and chert fragments.

Chert beds may be in the lower part of the soil, and dolomitic limestone bedrock is at widely variable depths ranging from 8 to 25 feet.

The natural fertility and organic-matter content are low and the reaction is medium to strongly acid. Internal drainage is medium to very rapid and the soil is easily permeable to both roots and moisture. The soil is moderate in capacity to hold moisture available to crops and is a little droughty where the content of chert is exceptionally high.

Use and management.—About three-fourths of this soil is cleared; the rest is under native deciduous forest, chiefly oaks. About 10 percent is used for crops. Corn and hay (mostly lespedeza, redtop, and orchard grass) are the chief crops. The rest of the cleared acreage is used for pasture. Little fertilization is practiced and little lime is applied. Under ordinary conditions corn yields about 22 bushels and lespedeza 1.0 ton or less an acre. Pastures are of relatively low quality; their carrying capacity does not exceed 75 cow-acre-days.

Chertiness, low fertility, and rather limited capacity for holding moisture available to plants restrict the usefulness of this soil for both tilled crops and pasture. The soil is low in productivity and rather difficult to work, but it is not particularly subject to loss of soil through runoff. Corn and hay are among the better suited crops; but if good yields are to be expected, heavy fertilization, adequate liming, and much organic matter are required.

Under a high level of management, corn should yield 45 bushels, lespedeza 1.7 tons, and tobacco 1,400 pounds an acre. The more desirable legumes and grasses can be maintained but good stands are more difficult to establish and hold than on many of the more fertile soils. Where adequate fertilization and liming, proper seeding, and control of weeds and brushy growth are practiced, pastures with a carrying capacity of about 105 cow-acre-days can be obtained.

Greendale cherty silt loam, rolling phase (5–12% slopes) (GA).—This soil differs from the undulating phase chiefly in having a stronger slope. It consists of very cherty colluvium and local alluvium washed chiefly from the associated Clarksville soils. The natural fertility and content of organic matter are low.

Use and management.—About 70 percent of the acreage is cleared; the rest is under deciduous forest, chiefly oaks. About 10 percent is used for crops, mainly corn, lespedeza, redtop, and orchard grass. The rest is used for pasture. Little fertilization is practiced and yields are low. The natural pasture plants are mainly lespedeza and broomsedge, with other volunteer vegetation. Their carrying capacity is about 70 cow-acre-days.

The soil is low in productivity and rather difficult to work but is not very susceptible to erosion. The very cherty nature, low fertility, and rather limited supplies of moisture held for plants restrict the usefulness of this soil for both tilled crops and pasture. Corn and hay are probably among the better suited crops. If they are to produce good yields, heavy fertilization, adequate liming, and much organic matter will be required. Under a high level of management, corn should yield 40 bushels and lespedeza 1.5 tons an acre.

The narrower strips occurring along drains within steeper areas of Clarksville and Fullerton soils are not well situated for cropping but are suitable for pasture. The more desirable legumes and grasses for pasture can be grown, although good stands are more difficult to maintain than on the more fertile soils. The droughtiness of much of the acreage limits the growth of pasture during dry periods. Nevertheless, where the fertility is brought to a high level and a good pasture cover is developed, the carrying capacity is about 100 cow-acre-days.

Gullied land, Armuchee and Litz soil materials (12–50% slopes) (GE).—This land type consists of areas of Armuchee, Litz, Dandridge, and Bland soils that have been reduced to a network of gullies by erosion. The areas range from a few acres to about 25 in size and are widely distributed throughout the Dandridge-Litz-Leadvale, the Sequoia-Litz-Dandridge, the Armuchee-Leadvale, and the Bland-Camp soil associations. The surface soil has been removed from most of the areas, and gullies of variable depth form an intricate pattern. The surface is too rough to allow the use of ordinary farm machinery and the prevailing relief is hilly or steep.

The exposed soil material in the Armuchee areas consists of yellowish-red firm silty clay. Much of the exposed material in the Dandridge areas is brownish-yellow friable shaly silty clay loam, and that in the Bland areas is weak-red firm silty clay. A few limestone ledges outcrop in the Armuchee and Bland areas, but the Dandridge and Litz areas are mostly free of hard rock outcrops, the bedrock being calcareous or soft weathered shale.

Use and management.—All this gullied land has been cleared and used for crops. Parts are now under volunteer pine forest or idle. An intermittent cover of sassafras, briers, and broomsedge is common to many of the idle areas but the cover on many parts is not sufficient to arrest erosion. A few areas may have an exceptionally good cover of kudzu, and here, as in the pine-covered areas, erosion is restrained and the soil is being slowly restored.

This land type is of little value except for forest. Shortleaf pine is well suited and can be expected to produce useful timber after growing 25 or 30 years. Kudzu is well suited to provide protection against erosion and is an economical means of rebuilding the areas for more desirable pasture plants. Some farmers may find it feasible to smooth these gullied areas and then establish fairly good pasture by heavy fertilization and careful seeding. This more rapid means of rebuilding the soil is more feasible in those areas that have milder slopes, shallow gullies, and no hard rock outcrops.

Gullied land, Fullerton and Talbott soil materials (12–50% slopes) (GF).—This land type consists of hilly and steep areas of Fullerton, Clarksville, Talbott, Dewey, and Decatur soils that have been greatly mutilated by erosion. The surface soil has been removed from a great part of the area, and gullies of variable depth form an intricate pattern. The surface is too rough for cultivation with ordinary farm machinery and the general relief is hilly and steep.

The tracts are widely distributed, chiefly in the Fullerton-Bolton-Clarksville soil association. This gullied land is much less common than Gullied land (Armuchee and Litz soil materials). Furthermore, its separate areas (2 to 10 acres) are smaller and less numerous because most of the soils from which it is derived are less subject to erosion than the Dandridge, Armuchee, Litz, Bland, and Sequoia soils.

The exposed soil material consists mostly of brownish-yellow to reddish-yellow firm cherty silty clay. The few areas of Dewey, Decatur, and Talbott soil material consist chiefly of red or yellowish-red firm to plastic silty clay. Most areas, except those of Talbott soil material, are free of bedrock outcrops. Where limestone bedrock outcrops are common, the gullies range in depth from less than 2 feet to 10 or 12 feet, and on the average are somewhat deeper than those common to Gullied land, Armuchee and Litz soil materials.

Use and management.—All of the acreage of Gullied land, Fullerton and Talbott soil materials, has been cleared and used for crops at some time. A small part is now under volunteer pine forest. A great part is idle and covered by sassafras, briers, and broomsedge. This cover in most places is not adequate to restrain erosion effectively. A few areas have a good cover of kudzu. In these and the pine-covered areas erosion is thoroughly restrained and the soil is slowly rebuilding.

This land type is of little value except for forest. Shortleaf pine is well suited and can be expected to produce useful timber after growing 25 or 30 years. Kudzu affords grazing and is well suited to provide protection against erosion. It is an economical means of rebuilding the areas for more desirable pasture plants.

It may be practical to construct check dams to stop further development of ditches and gullies. In places, diversion ditches along the upper edges of the areas will be useful in reducing runoff water passing through the gullied areas. Some farmers may find it feasible to smooth the less severely gullied parts and to establish fairly good pasture by heavy fertilization and careful seeding.

Gullied land, Sequoia and Montevallo soil materials (4–12% slopes) (GG).—This gullied land consists of areas of Sequoia, Jefferson, and Montevallo soils that have been mutilated by erosion. The

separate areas are small but relatively numerous; most of them are in the Jefferson-Montevallo, the Montevallo, the Sequoia-Litz-Dandridge, and the Sequoia-Leadvale soil associations. Generally the surface soil has been removed from a great part of the areas and shallow gullies form an intricate pattern. The surface is too rough to be cultivated with ordinary farm machinery.

The exposed soil consists chiefly of brownish-yellow friable to firm shaly clay loam, although in many places it is predominantly variegated yellowish-brown and gray acid shale. There are few or no hard rock outcrops. Practically all of the surface soil has been removed; gullies are seldom more than 2 or 3 feet deep.

Use and management.—All of the acreage of this gullied land has been cleared and used for crops. Parts are now under volunteer pine forest but most of the land is idle and has an intermittent cover of sassafras, briers, and broomsedge that is not sufficient to stop erosion. In the few areas under kudzu or forested with pine, erosion is thoroughly restrained and the soil is being slowly restored.

This land type is of little value except for forest. Shortleaf pine is well suited and can be expected to produce useful timber after growing about 30 years. Kudzu affords some grazing and is effective against erosion. It provides an economical means of rebuilding the areas for more desirable pasture plants but growth will not be as luxuriant as on the more naturally fertile areas of Gullied land, Fullerton and Talbott soil materials; and Gullied land, Talbott and Decatur soil materials. It may be found feasible to construct check dams and diversion ditches. On some farms it may be practical to smooth off gullied areas with heavy tillage implements and establish fairly good pasture by heavy fertilization and careful seeding. In general, use of heavy tillage implements on this gullied land will be more feasible than on the more strongly sloping gullied lands because the gullies are generally shallow and runoff is not quite so active.

Gullied land, Talbott and Decatur soil materials (4–12% slopes) (GH).—This gullied land consists of former areas of Talbott, Decatur, and Dewy soils. The surface soil has been removed from a great part, and intricate gullies of moderate depth have formed. The areas are not numerous but are widely distributed in parts of the Stony land-Talbott and the Decatur-Dewey-Emory soil associations, more commonly in the Stony land-Talbott. The surface is too rough for ordinary farm machinery; the general relief is rolling.

The exposed soil material consists chiefly of red or yellowish-red firm to plastic silty clay. Bedrock outcrops are not common in areas associated with the Dewy and Decatur soils but are common in those associated with the Talbott.

Use and management.—All of this gullied land has been cleared and used for crops. A small part is under pine forest; a great part is idle. The idle areas are partly covered by sassafras, briers, and broomsedge or are bare. The plant cover generally is not adequate to stop erosion. A few areas may have a good cover of kudzu, and here, as in the pine-covered areas, erosion is restrained and the soil is being slowly remade.

This land type is of little value except for forest. Shortleaf pine is well suited. Kudzu provides some pasture and is an effective cover as well as an economical means of rebuilding areas for the production of such more desirable plants as bluegrass and white clover. It may

be feasible to use some of the rejuvenated areas for other crops. Crops requiring tillage are not suited because of the poor tilth, erodibility, and droughtiness of the soil. In many places planting of sod crops and digging of diversion ditches around the heads or upper limits of the gullied areas and building check dams in the larger gullies may be practical. Farmers may find it feasible to smooth some gullied areas and then establish fairly good pasture by heavy fertilization and careful seeding. This method is more feasible on this gullied land than on most areas of the others, since the soil material is relatively fertile and has less slope.

Gullied land, Tellico and Muskingum soil materials (12–50% slopes) (GK).—This miscellaneous land type is made up of Tellico, Muskingum, and Lehew soils that have lost the surface soil from a great part of their area and are cut by intricate gullies. The depth of the gullies varies greatly. Some gullies are not more than 2 feet deep; others, especially those on the more sloping areas, may be 7 to 10 feet deep. The separate areas of this land type are not numerous. They range from a few to about 75 acres in size and are widely distributed throughout the Tellico-Neubert soil association. The surface is much too rough for ordinary farm machinery; the general lay of the land is hilly or steep.

The exposed soil material in areas of the Tellico-Neubert soil association consists of dark-red friable silty clay; elsewhere it is more yellowish friable silty clay. Hard bedrock outcrops are common in some areas.

Use and management.—All of this gullied land has been cleared and used for crops. Some is now under volunteer pine forest, but a great part is idle and partly or entirely bare of vegetation. An intermittent cover of sassafras, briers, and broomsedge is common to much of the idle land. Generally this cover is not enough to stop erosion. A few areas have a good cover of kudzu. In areas covered by kudzu or by pine forest, erosion is thoroughly restrained and the soil is slowly building.

This miscellaneous land type is of little value for forest, but shortleaf pine is well suited and can be expected to produce useful timber after growing 25 or 30 years. Kudzu, which is relatively easy to establish, provides some pasture and effective protection against erosion. Growing this plant is an economical way of rebuilding areas for eventual production of more desirable pasture. In places it may be practical to build check dams in the larger gullies. These will stop further gullying and collect material suitable for plant growth. In many places digging diversion ditches at the heads of gullies will aid greatly by removing runoff to less erosive channels. Some farmers may find it feasible to smooth the less severely gullied areas and establish fairly good pasture by heavy fertilization and careful seeding. Smoothing this gullied land is less practical, however, because the gullies are deep and bedrock outcrops may interfere with the work.

Guthrie silt loam (0–2% slopes) (GL).—This light-colored very poorly drained soil occurs in depressions or sinks and along intermittent drains. The surface is nearly level in the sinks and very gently sloping along the drains. Those areas in sinkholes usually have no surface drainage outlets. The soil is associated with Fuller-

ton soils on the cherty ridges, Talbott and Colbert soils in limestone valleys, and Sequoia soils in the shale valleys. It is made up of local alluvium washed from these soils, largely material from limestone or interbedded limestone and shale. It is of small extent and its separate areas are small.

Profile description:

0 to 6 inches, gray silt loam.
6 to 16 inches, light-gray very firm silty clay.
16 inches +, light-gray, mottled with yellow and brown, very firm silty clay or clay; limestone or shale bedrock at widely variable depths, in most places at 10 to 30 feet.

Small brown concretions are common to the subsoil. In places a light-brown or brown silt loam layer of very recent alluvium, 3 to 4 inches thick, is on the surface.

This soil is low in organic matter and plant nutrients and strongly acid. Internal drainage is very slow, and the subsoil is not very permeable to roots. Moisture content fluctuates greatly. During wet periods the soil may be ponded, and during the driest periods the water table is several feet below the surface and the soil is hard and dry. Accordingly, optimum moisture conditions for the crops commonly grown exist for relatively short periods. The soil is either too wet or too dry a great part of the time.

Use and mangement.—A great part of this soil is cleared and used chiefly for hay and pasture. A small total acreage is used for sorghum, soybeans, and Sudan grass. Where seeded, lespedeza and redtop are the predominant hay and pasture plants. Much of the pasture on this soil, however, consists of voluteer grasses with some lespedeza. Little fertilization is practiced. Lime is not commonly used although some areas have been treated with about 2 tons of ground limestone an acre. Under ordinary conditions lespedeza produces 0.4 ton an acre and pasture about 35 cow-acre-days of grazing.

Unfavorable moisture content and low fertility make this soil poorly suited to tilled crops. Tilth is good only under the most favorable conditions. The problem of conserving soil material, however, is small because erosion is not a hazard. Adequate applications of lime and phosphorus will improve pastures. The use of artificial drainage, lime, organic matter, and fertilizer will make the soil productive of such crops as corn, small grains, orchard grass, bluegrass, and white clover. Cost may make adequate drainage impractical for cropland. Draining is feasible for pasture, as less drainage is required. Where adequate drainage is feasible and fertilizer, lime, and organic matter are added, 28 bushels of corn, 1.2 tons of lespedeza, or 60 cow-acre-days of grazing an acre can be expected.

Hamblen fine sandy loam (0–3% slopes) (HA).—This is an imperfectly drained soil on bottom lands along some of the creeks. The tracts along the smaller creeks occupy the entire bottom land. Those along the larger ones, such as Bullrun Creek, are irregular and occur in association with Staser and Prader soils and Hamblen silt loam. The soil is made up of mixed alluvium, derived in part from sandy parent rocks. The parent rocks contributing to the alluvium are acid shale, calcareous shale, calcareous sandstone, and limestone. Most of the soil is slightly acid; but it is medium acid in a few areas where much of the parent material was washed from Muskingum and Lehew

soils. The reaction is alkaline where the material was washed predominantly from Dandridge soils.

The color of Hamblen fine sandy loam varies according to the nature of the parent rock. Areas consisting of material largely from Muskingum and Lehew soils, or about two-thirds of the aggregate soil area, have a profile as follows:

0 to 8 inches, brownish-gray fine sandy loam.
8 to 20 inches, yellowish-brown firm fine sandy loam to silt loam that may be mottled somewhat in the lower part.
20 to 40 inches, mottled grayish-yellow and brown material ranging from loamy fine sand to silt loam; shale or limestone bedrock at widely variable depths ranging from 5 feet to as much as 30.

A red variation of this soil occupies nearly all of the bottom lands along the creeks throughout the Tellico-Neubert soil association. It consists of material largely from Tellico soils and makes up about one-third of the aggregate soil area. A profile description follows:

0 to 8 inches, reddish-brown fine sandy loam or loam.
8 to 16 inches, slightly lighter shade of reddish-brown fine sandy loam, fine sandy clay loam, or silty clay loam.
16 to 30 inches, brown, mottled with gray and very dark-brown, sandy clay loam or sandy clay; shale or limestone bedrock at widely variable depths, usually more than 5 feet and less than 15 or 20.

Some areas of Hamblen fine sandy loam have a relatively dark layer 4 to 8 inches thick and 10 to 18 inches below the surface. It appears to be an old surface layer that has been buried by recent overwash from cultivated fields. In some places there are shale fragments, but not enough to prohibit tillage. Some areas that have a loamy fine sand texture are too small to be shown separately on the soil map. Where the water table is near the surface, wet spots appear part of the time and the soil is mottled or gray near the surface. These spots were also too small to be mapped as poorly drained soils, but most of them are designated on the soil map by appropriate symbol.

The natural fertility of this soil is medium; the content of organic matter is low to moderate. The reaction ranges from moderately acid to alkaline. Internal drainage is slow, and for the crops commonly grown there is an excess of moisture much of the year. During the drier seasons the water table may be 3 or 4 feet below the surface, but during periods of heavy rainfall the areas may be inundated. During much of the growing season, the water table is 18 to 36 inches below the surface. The soil material is permeable to both roots and moisture.

Use and management.—A great part of this soil is cleared; probably two-thirds is used for corn and hay, and the rest for pasture. Corn may be grown several years in succession. Fertilization is not commonly practiced. Under ordinary conditions corn yields about 35 bushels and lespedeza 1.4 tons an acre. Pastures consisting of broomsedge, Bermuda grass, bluegrass, and, in places, some white clover are common; their carrying capacity is about 75 cow-acre-days.

The smooth surface, ability to respond to fertilization, and good tilth make this soil well suited to intensive production of row crops. Its slow internal drainage and susceptibility to flooding limit its range of suitability. Among the better suited crops are corn, soybeans, and pasture plants, and such hay as orchard grass, lespedeza

and other legumes, timothy, and redtop. Its relatively abundant supply of moisture makes this soil particularly desirable for midsummer pasture. Vegetation lasts longer on it during dry periods than on most of the higher lying soils. Much of the acreage will respond to lime but some areas do not need it. Most crops can be expected to respond to fertilizer and organic matter. Where a relatively high level of fertility is maintained and water does no damage during excessively rainy periods, corn will yield 55 bushels, lespedeza 1.9 tons, and pasture about 110 cow-acre-days of grazing.

Hamblen silt loam (0–2% slopes) (Hb).—This is an imperfectly drained soil on creek bottoms. It consists chiefly of material washed from shales, although in practically all areas some of the material is derived from limestone. The largest tracts are along Bullrun Creek and in Hinds Valley; others are widely distributed over the county. The soil differs from Hamblen fine sandy loam chiefly in having a finer texture throughout its depth.

Profile description:

0 to 10 inches, light yellowish-brown silt loam.
10 to 24 inches, light yellowish-brown silt loam or silty clay loam with some light yellow and gray streaks; a few mottles in the lower part.
24 inches+, mottled gray and brown silty clay loam or silty clay; shale bedrock at widely variable depths ranging from 5 to 30 feet.

Some areas have a dark layer 8 to 20 inches below the surface that apparently represents an old surface layer that has been buried by recent overwash.

The natural fertility of this soil is moderately high. The reaction ranges from medium acid to alkaline; it is moderately acid where the material is predominantly from acid shale, and more nearly alkaline where it consists chiefly of alluvium from calcareous shale. The tilth of the plow layer is favorable, although cultivation is postponed until rather late in spring because the soil is usually too wet to be worked.

Use and management.—Practically all of the soil is cleared. It is used for corn, hay, pasture, and in places for intensive production of row crops. Fertilization is not so commonly practiced as on the soils of the upland. Periodic inundation by floods aids greatly in maintaining the fertility of this soil. Under ordinary management corn yields about 40 bushels and lespedeza 1.5 tons an acre. Common pasture is of fairly good quality and has a carrying capacity of approximately 110 cow-acre-days.

The smooth surface, relatively good tilth, moderately high fertility and generally abundant moisture supply make this soil well suited for intensive use. Its imperfect internal drainage and susceptibility to flooding, however, limit its range of suitability for crops. Corn, soybeans, and such hay and pasture plants as lespedeza, orchard grass, timothy, redtop, and bluegrass are among the better suited crops. In its natural state the soil is particularly suitable for permanent pasture, as moisture relations are favorable for grasses and legumes during the drier parts of the growing season.

The lime requirement varies. The more acid areas probably need about 2 tons of ground limestone every 5 to 6 years; the more alkaline areas need no lime. Crops will respond to fertilizer and manure.

Where a wider crop adaptation is desired, many areas can be improved by artificial drainage. The feasibility of drainage will depend upon costs and other factors.

Huntington silt loam (0–2% slopes) (Hc).—This very fertile well-drained soil consists of mixed alluvium that has been strongly influenced by limestone or has been derived largely from limestone material. It occurs on first bottoms, usually on the higher parts, along the Tennessee and Holston Rivers. The long nearly level strips are near the river channels. In places the tracts are separated from the river channel by a narrow strip of Huntington silt loam, low-bottom phase, or Staser fine sandy loam, low-bottom phase. There is a steep slope or escarpment between these soils. Although the escarpment is small in area, it greatly impedes field work.

Profile description:

0 to 28 inches, brown or dark-brown silt loam.
28 to 60 inches, brown, grading to light-brown, silty clay loam having some gray mottlings in the lower part; bedrock at considerable depths—in most places 15 to 40 feet below the surface.

Some areas have a more loamy surface layer and subsoil; others have a darker (dark-brown) layer 10 to 20 inches below the surface that is apparently an old surface layer that has been buried by recent overwash.

The natural fertility of this soil is exceptionally high and the organic-matter content is at least moderate. The reaction ranges from slightly acid to slightly alkaline. Internal drainage is medium. The soil is easily permeable to both roots and moisture and its capacity for holding moisture available to plants is high. The water table is usually several feet below the surface except during the wettest periods. Under natural conditions the soil was subject to periodic overflow, although less so than the associated Lindside silt loam and low-bottom phases of Staser and Huntington soils. Flooding can be expected to be less frequent since the construction of flood-control dams upstream from Knox County on the French Broad and Holston Rivers.

Use and management.—Practically all of this soil is cleared. Corn has been grown continuously on a large part for many years, and this use has somewhat lowered the productivity. At present about one-fourth is used for corn and one-fourth for small grains; the rest is used for hay or pasture. Rotations and fertilizers have not been generally used. A rotation used is corn, 1 year; a small grain, 1 year, and lespedeza or red clover and timothy, 2 years. Corn is grown every year in places, and yields are maintained at a relatively high level by turning under a crop of crimson clover almost every spring. On most farms corn receives little or no fertilizer, small grains receive 100 to 200 pounds of 16- to 20-percent phosphate or 0–10–4 fertilizer, and alfalfa receives larger applications of commercial fertilizers and 2 to 3 tons of lime an acre. Corn yields about 45 bushels, wheat 15 bushels, and hay (mostly timothy and red clover, lespedeza, Johnson grass, or alfalfa) 1.5 to 3.2 tons an acre.

This soil is well suited to crops that require tillage. It is highly productive and easily worked and conserved. If the fertility is kept at a high level, this soil will produce a wide variety of crops and can

be used intensively for row crops. The susceptibility to occasional flooding is somewhat a hazard to crops. The soil requires little or no lime and retains plant nutrients well. Where corn is grown in successive years, crimson clover, used as a winter cover crop and turned under in the spring, will help maintain high fertility. Pasture of good quality is easily established but weedy growth is a decided problem. Because of favorable moisture relations, pastures are better on this soil during drier periods than on most of the higher lying soils.

Huntington silt loam, low-bottom phase (0–2% slopes) (HD).—This very fertile well-drained soil occurs on first bottoms along the Tennessee and Holston Rivers. The narrow nearly level strips are adjacent to the river channels. The soil consists of mixed alluvium strongly influenced by limestone or mixed alluvium derived largely from limestone material. This phase differs from Huntington silt loam chiefly in its notably lower position, somewhat more recent alluvium, and greater susceptibility to flooding.

To a depth of several feet the soil is brown or dark grayish-brown silt loam or loam. Loamy or sandy spots are more common than in Huntington silt loam. Some mottlings may occur below 3 or 4 feet.

The natural fertility is exceptionally high, and the content of organic matter is at least moderate. The reaction ranges from slightly acid to slightly alkaline. Internal drainage is medium. The soil is permeable to both roots and moisture and its capacity for holding moisture available to plants is high. The water table is generally several feet below the surface except during the wettest periods. This soil may still be subject to occasional inundation, though this hazard has been lessened by the construction of dams that control floodwaters upstream from Knox County on the French Broad and Holston Rivers.

Use and management.—Much of the acreage is cleared and used for crops. A great part is in corn, which receives little or no fertilizer but yields 40 to 75 bushels an acre.

This soil is well suited to tilled crops and can be used intensively for row crops without undue deterioration. Lime is not ordinarily required, but some response to phosphorus and organic matter can be expected. Where corn is grown in successive years, a winter cover crop of crimson clover will help maintain high production. Pasture produces well. The more exacting legumes and grasses, including white clover and bluegrass, will maintain a high carrying capacity. As on many of the other soils of the bottom lands, Johnson grass is common; though it is a weed in many crops, it is useful as volunteer hay.

Jefferson loam, eroded rolling phase (5–12% slopes) (JD).—This light-colored loamy soil occurs on gentle slopes at the foot of steep ridges occupied by the Muskingum-Lehew soils. It consists of colluvium that has worked down or washed from the Muskingum-Lehew areas. Most of the areas have a gentle slope away from the adjoining ridges. Many slopes are about 8 percent but some are as low as 2.

Profile description:

0 to 6 inches, yellowish-gray or grayish-yellow fine sandy loam or loam.
6 to 20 inches, brownish-yellow friable clay loam.
20 inches+, streaked or reticulated yellow, red, and gray friable clay loam.

Shale bedrock is at depths of 3 to 12 feet. In spots, however, bedrock is at a somewhat shallower depth. Sandstonelike fragments and pebbles are common in places but do not interfere with tillage. The amount of soil material lost through erosion varies greatly. On the more exposed slopes, practically all of the surface soil has been lost and the plow layer consists of yellowish-brown clay loam.

The natural fertility is low, and the reaction is medium to strongly acid. Internal drainage is medium. The soil is permeable to roots and moisture and moderate in water-holding capacity.

Use and management.—Much of this soil has been cleared, but parts are now idle. The cropped areas are used chiefly for corn, hay, some vegetables, and small grains. About one-quarter of the acreage is in pasture, chiefly lespedeza and broomsedge. Some fertilizer is applied, and much of the land has been limed. Under ordinary conditions corn yields about 22 bushels and lespedeza about 0.7 ton.

This soil is suited to practically all the crops commonly grown, but its rather low fertility limits yields except where large quantities of fertilizer and organic matter have been added. The smoother parts, where the slope does not exceed 4 or 5 percent, are suited to moderately short rotations (about 3 years), if fertility is kept high. On the more sloping areas, where the slope ranges from 5 to 12 percent, moderately long rotations are required and care should be taken to carry on field operations according to the contour.

Small grains, lespedeza, red clover, and alfalfa are well suited if adequate fertilization is practiced. Such row crops as corn, tobacco, and truck crops are suited where care is taken to restrain erosion. The permeable friable nature of the less eroded parts makes the soil particularly well suited to root crops. The more severely eroded areas are better used for close-growing small grains, hay, and pasture crops. Where good management is practiced, including adequate fertilization and additions of organic matter and lime, oats can be expected to yield 32 bushels, alfalfa 2.6 tons, and tobacco about 1,200 pounds an acre. Pastures of well established lespedeza and orchard grass can be expected to have a carrying capacity of about 90 cow-acre-days. Good stands of alfalfa, white clover, and other exacting legumes can be maintained only if fertility is kept at a high level.

Jefferson and Montevallo loams, eroded undulating phases (2–5% slopes) (Jc).—This combination of soils occupies the relatively smooth parts of the foot slopes below the steep ridges of Muskingum-Lehew soils. It is widely distributed throughout the Jefferson-Montevallo soil association.

The areas of the Jefferson soil consist of colluvium. They have a 4- to 6-inch grayish-yellow fine sandy loam or loam surface layer, below which is brownish-yellow friable clay loam. Below 20 inches the material is streaked or reticulated yellow, red, and gray friable clay loam. Depth to shale bedrock normally ranges from 24 to 36 inches, although in places it is much less.

The areas of Montevallo soils occupy about 35 percent of the total acreage; they consist of a thin layer of residuum from acid shale. The 3- to 5-inch surface layer is yellowish-gray silt loam containing a variable amount of shale fragments. Below this is brownish-yellow friable shaly clay loam. At 12 inches occurs variegated or streaked olive-yellow, reddish-brown, and gray partly disintegrated shale. In

many places the shaly clay loam layer is lacking. In these the yellowish-gray surface layer grades to the varicolored partly disintegrated shale. The less weathered bed of shale occurs at depths ranging from 6 to 20 inches.

The natural fertility of these soils ranges from low (Jefferson) to very low (Montevallo), and the content of organic matter is low. The reaction is moderately to strongly acid. The areas of the Jefferson soil are permeable to both moisture and roots and have moderate capacity for holding moisture available to plants. The shallow depth to shale bedrock makes the Montevallo soil droughty, and its very slow absorption of moisture causes runoff to develop quickly during rains.

Use and management.—A great part of these soils has been cleared, but approximately 20 percent is still under forest. Much of the cleared acreage is used for crops and pasture. In some sections, however, large areas are idle. Corn, small grains, and hay, mainly lespedeza, are the chief crops. The level of management varies greatly. In some places the soils continue to decline in productivity, and in others they are improving.

Low fertility and shallowness limit the suitability of the Montevallo soil for crop and pasture use. The Jefferson soil areas, more productive and more easily worked, are more desirable for crops, but in many places it is not feasible to farm them separately from the Montevallo soil. On most areas use of moderately long rotations and regular application of lime and fertilizer are necessary to maintain good yields. Truck crops and certain other row crops are suited to the Jefferson soil areas that are large enough to be farmed separately from the Montevallo. Where the fertility and organic-matter content are kept relatively high, areas of these soils can be expected to yield about 30 bushels of corn, 1.4 tons of lespedeza, and 80 cow-acre-days of grazing.

Jefferson and Montevallo loams, eroded rolling phases (5-12% slopes) (JB).—This combination of soils differs from the eroded undulating phases of Jefferson and Montevallo loams chiefly in having a stronger slope and a greater area of Montevallo soil. In general the higher and smoother parts are Jefferson soil and the more sloping parts are Montevallo soil. Most areas of these soils are moderately eroded, although there are patches too small to map separately that are severely eroded. In the severely eroded patches, the plow layer consists of subsoil material; that is, either brownish-yellow clay loam characteristic of the Jefferson subsoil, or very shaly material with some silty clay characteristic of the Montevallo subsoil.

The natural fertility and content of organic matter are low, and the reaction is moderately to strongly acid. The Jefferson soil has favorable permeability and capacity for holding moisture available to plants, but Montevallo soil has somewhat slower moisture infiltration and very low moisture-holding capacity.

Use and management.—Much of this mapping unit has been cleared but a considerable area is now idle or has reverted to pine forest. A fair acreage is used for unimproved pasture, and other parts for such crops as corn, lespedeza hay, and small grains. Common management is not at a high level and crop yields are low.

The suitability of this combination of soils for farming varies widely. The less eroded areas of Jefferson soil are suited to most of the crops commonly grown, providing moderately long rotations are used. The Montevallo soil areas are not particularly well suited to crops; but if long rotations and adequate fertilization are practiced, fair crop yields can be expected except on the more eroded parts. Relatively heavy applications of organic matter, plant nutrients, and lime are required if moderately high yields are to be realized from the best suited crops. Such hay crops as lespedeza, orchard grass, and, on the more favorable sites, red clover and alfalfa are well suited. Fall-sown small grains grown in rotation with these hay crops will yield fairly well if soil fertility is kept high. Row crops such as corn can be grown satisfactorily on the Jefferson areas but they cannot be used at intervals of less than 4 or 5 years if the productivity of the soil is to be improved and sustained. If fertility is improved, good quality grazing can be produced. Its carrying capacity, under favorable conditions, will be about 70 cow-acre-days where both soils are in the same field.

Jefferson and Montevallo clay loams, severely eroded rolling phases (5–12% slopes) (JA).—This combination of soils differs from the eroded undulating phases of Jefferson and Montevallo loams chiefly in being more eroded, in having a stronger slope, and in having a greater predominance of the Montevallo soil. There are a few gullies too large to be filled by tillage or too deep to be crossed with farm machinery. These soils are associated with other Jefferson and Montevallo soils in the Jefferson-Montevallo soil association.

In this undifferentiated unit the plow layer consists of brownish-yellow clay loam in the Jefferson soil areas and brownish-yellow friable very shaly clay loam in the Montevallo soil areas. Throughout, partly disintegrated acid shale is at a relatively shallow depth and, in places, at the surface. Small gullies are common but many can be obliterated by tillage.

The natural fertility of these severely eroded rolling phases is low, and the content of organic matter is very low. All of the soil material is moderately to strongly acid, and the capacity of the soils for holding moisture available to plants is very low. Tilth is unfavorable, and runoff develops quickly during rains.

Use and management.—All of the acreage has been cleared at some time, but much of it is now idle or used as unimproved pasture. Unfavorable moisture relations, poor tilth, and low fertility make the soils of this mapping unit poorly suited to crops that require tillage. If adequately fertilized and properly seeded, they afford some grazing. The carrying capacity under favorable conditions is about 45 cow-acre-days.

Leadvale and Cotaco loams, undulating phases (0–7% slopes) (LB).—The soils in this undifferentiated combination are derived from local alluvium occurring along the upper reaches of drainageways (pl. 9, *A*). They consist chiefly of slightly sandy material washed from areas of Muskingum, Lehew, and Jefferson soils. The very gently sloping areas occur in strips along drainageways in the shale valleys in which Montevallo and Jefferson soils predominate.

Most of these strips are along drainageways arising in areas of steep Muskingum and Lehew soils and are somewhat more sandy than the strips occurring along the drainageways that are largely in areas of Montevallo soils. A notable part of this undifferentiated combination is in Hinds Valley and southeast from House Mountain and McAnnally Ridge.

The Cotaco soil consists of local alluvium and occurs on the lower areas next to the drainageways. The Leadvale soil consists of local alluvium occurring mainly on the higher areas somewhat removed from the drainageways.

Profile description of the Cotaco soil:

0 to 8 inches, gray or yellowish-gray fine sandy loam to loam.
8 to 24 inches, mottled yellow, gray, and brown, friable fine sandy clay loam to clay loam.
24 to 40 inches, light yellowish-gray and yellow very fine sandy clay or silty clay loam; some brownish mottlings; dark concretions common; shale bedrock at depths of 4 to 15 feet.

Profile description of the Leadvale soil:

0 to 8 inches, light-gray to yellowish-gray loam or silt loam.
8 to 24 inches, yellow firm silty clay loam.
24 inches+, mottled yellow and gray firm but somewhat friable silty clay loam; shale bedrock at depths of 4 to 15 feet.

In general the tracts of this combination occurring along drains chiefly within areas of Montevallo soils have a silt loam surface soil, whereas those along drains originating chiefly in Muskingum and Lehew soils have a more sandy surface soil.

The fertility of these soils is moderate, and the content of organic matter is rather low. The reaction is medium to strongly acid. Internal drainage is moderately slow to slow. The soil material is permeable to both roots and moisture, but the subsoil of the Leadvale is firmer and more slowly permeable to moisture than that of the Cotaco. The water table in the Cotaco soil areas fluctuates greatly. During the wettest seasons it is approximately at the surface, and during the drier seasons it may be 3 to 5 feet below the surface. Moisture is usually somewhat excessive during part of the growing season for many crops commonly grown, but is adequate for such crops as corn, lespedeza, and permanent pasture.

Use and management.—Much of the area is cleared and used for corn, pasture, and hay. Some fertilization is practiced and some fields have been limed. Under ordinary conditions, where both soils occupy the same field, corn yields about 32 bushels and lespedeza about 1 ton an acre. Pasture is not of high quality, but the favorable moisture relations give a relatively long grazing period.

The smooth surface, good moisture relations, fairly good tilth, and responsiveness to fertilization make these soils well suited to some crops, particularly corn and certain legumes and grasses for hay and pasture. They are not well suited to alfalfa and many truck crops. The lower lying areas are not suited to small grains, chiefly because of excessive moisture in the Cotaco soil. Where adequate fertilization is practiced, they are particularly well suited to pasture and to short crop rotations.

If the more desirable grasses and legumes are to be grown, lime and heavy fertilization are required. Where row crops are to be

grown or pasture established, organic matter will be of considerable value in producing high yields. The Cotaco soil can be improved by artificial drainage, especially for row crops. The feasibility of drainage will depend on a number of factors. Where management of this combination of soils is kept at a high level and drainage is adequate, corn should yield 52 bushels; lespedeza, 1.6 tons; and pasture, 140 cow-acre-days of grazing an acre.

Leadvale and Cotaco loams, rolling phases (7–16% slopes) (La).—This combination of soils differs from the undulating phases of Leadvale and Cotaco loams mainly in having stronger slopes. Some slopes reach gradients of 20 percent. The Leadvale soil occupies a larger proportion of this mapping unit than it does of undulating phases of Leadvale and Cotaco loams. Accordingly, the acreage is smaller in which drainage is notably impaired. The areas occur as narrow strips along drainageways in shale valleys in which Montevallo and Jefferson soils predominate.

Use and management.—Much of the area of these soils is cleared and used for hay, pasture, and corn. Lespedeza is the chief hay crop. Some pastures consist chiefly of lespedeza and others predominantly of broomsedge. Fertilization is practiced for corn, and lime has been applied to some areas.

These soils are suitable for tilled crops, but moderately low fertility, more rolling slopes, and somewhat impaired drainage limit the natural productivity and range of suitability. The stronger slopes require moderately long rotations if the soils are to be adequately conserved. The lime requirement is high, and additions of the usually deficient plant nutrients and organic matter are necessary if good yields are to be obtained. As with the undulating phases of Leadvale and Cotaco loams, the Cotaco soil areas have exceptionally good moisture relations for midsummer pastures. If adequately fertilized and seeded, the Cotaco areas have a carrying capacity of approximately 135-cow-acre-days. Under a high level of management these soils can be expected to yield 50 bushels of corn and 1.6 tons of lespedeza an acre.

Leadvale and Whitesburg silt loams, undulating phases (0–7% slopes) (Ld).—The soils of this combination lie as strips along drainageways in association with the soils developed from calcareous shale and interbedded acid shale and limestone. Their material was derived mainly from the Sequoia, Armuchee, Litz, and Dandridge series. These are among the more extensive of the soils developed on colluvium and are widely distributed throughout the Sequoia-Leadvale, Sequoia-Litz-Dandridge, Dandridge-Litz-Leadvale, and Armuchee-Leadvale soil associations.

The Whitesburg soil is derived from colluvium or local alluvium composed of materials originating chiefly in areas of calcareous shales. It predominates in areas immediately adjacent to the drainageways. There is no strong textural distinction between the surface and subsoil layers, and the reaction is less acid than that of the Leadvale soil. The surface 10 inches is brownish-gray silt loam. Below this and extending to about 18 inches is light-yellow silt loam or silty clay loam. Below 18 inches is mottled light-yellow and gray silty clay loam.

The Leadvale soil predominates in the higher areas more removed from the drainageways, although in places it is also directly adjacent. The surface 8 inches of the Leadvale soil ranges from grayish-yellow to gray silt loam. Below this and continuing to a depth of about 24 inches is yellow firm silty clay loam. The material below this depth is mottled yellow and gray firm but friable silty clay loam. Shale bedrock is at depths of 4 to 15 feet.

Internal drainage is slow, and during the wetter periods the water table is at or near the surface in areas adjacent to the drainageways. The soil material, however, is permeable to both roots and moisture. The natural fertility is moderate but the organic-matter content is rather low. The reaction ranges from moderately acid to slightly alkaline in the Whitesburg soil and from moderately to strongly acid in the Leadvale soil.

There are a few areas of this combination of soils that have good internal drainage, and here the surface soil is a little browner and the subsoil is free of mottlings to a depth of more than 30 inches. These areas can be expected to be somewhat more fertile and suited to a wider variety of crops than most of the others.

Use and management.—Most of this soil combination is cleared and used for hay and pasture. Some corn and small grains and a small amount of tobacco are grown. Lespedeza and redtop are the chief hay and pasture plants. Lime has been applied to much of the acreage. Corn and small grains receive moderate fertilization. Under ordinary conditions corn yields about 40 bushels and lespedeza about 1.1 tons an acre. Pasture has a carrying capacity of about 90 cow-acre-days.

These soils are well suited to many of the crops commonly grown. They are moderately productive, easily worked, and easily conserved. Their slow internal drainage, however, makes them poorly suited to such crops as alfalfa and restricts periods of cultivation. Where adequately fertilized and limed, they can be used intensively for row crops, as runoff is not an erosion hazard. Small grains and hay are among the best suited crops. Much of the acreage, especially of the Whitesburg soil, is desirable for pasture, since the moisture relations favor a long growing season. Relatively heavy fertilization and, on the Leadvale soil, adequate applications of lime, are necessary if relatively high yields are to be realized. Under good management corn will yield 55 bushels and lespedeza about 1.7 tons an acre. Where the fertility has been brought to a high level, the more desirable pasture plants such as orchard grass, bluegrass, white clover, and lespedeza provide about 145 cow-acre-days of grazing.

Leadvale and Whitesburg silt loams, rolling phases (5–12% slopes) (Lc).—These soils occur along drainageways in the Sequoia-Leadvale, Sequoia-Litz-Dandridge, Dandridge-Litz-Leadvale, and the Armuchee-Leadvale soil associations. They differ from the undulating phases of Leadvale and Whitesburg silt loams chiefly in having strong slopes. In general the proportion of Leadvale soil is greater in this combination of soils than in the undulating phases of Leadvale and Whitesburg silt loams. Internal drainage, though rather slow, is somewhat better than in the undulating phases. Only a small part of these rolling phases has a high water table during the wetter seasons.

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Use and management.—Much of the acreage of these soils has been cleared and is used for small grains, hay, and pasture. A small amount is used for corn. Pasture and hay are not of high quality; they generally consist of lespedeza, broomsedge, and some redtop. Some areas have been limed, and some fertilization is practiced. The more remote areas—those in the hillier landscapes—do not receive much fertilization. Crop yields under ordinary conditions are not high.

These soils are well suited to many of the crops commonly grown; but chiefly because of the stronger slope, somewhat longer rotations are required and more care is necessary in controlling runoff than for the undulating phases of Leadvale and Whitesburg silt loams. Small grains and hay and pasture crops are best suited, although row crops such as corn and tobacco will produce well where the fertility and organic-matter content are maintained at high levels. Some areas may be suited to alfalfa, but those adjacent to the drains are generally too wet.

Limestone rockland, rolling and hilly (2–25% slopes) (LE).—This land type occupies gently sloping to hilly areas where limestone outcrops and loose rock cover a great part of the surface. Most of it is in the Stony land-Talbott soil association. There is a small amount of soil material that resembles Talbott and Colbert soils in texture and consistence, but it occupies less than 25 percent of the surface and ranges from only a few inches to 12 inches thick over bedrock. This soil material is fertile but so shallow to bedrock and limited in extent that it is of no value for crops that require tillage and of little value for pasture. Most of it supports a scrubby growth of cedars, oaks, and underbrush.

Limestone rockland, steep (25+% slopes) (LF).—This land type differs from Limestone rockland, rolling and hilly, chiefly in having stronger slopes. The gradient ranges up to 60 percent. Much of it occurs as bluffs along larger streams and around quarries. In a few places the slopes are precipitous, or clifflike. A great part of the surface is occupied by limestone outcrops and loose rock. There is a small amount of soil material in the interstices. The vegetation is predominantly cedars and scrubby deciduous trees, chiefly oaks, with a variable amount of brushy growth intermixed. This land is valueless for crops, pasture, or even forest cover. Trees are small and grow slowly.

Lindside silt loam (0–2% slopes) (LG).—This imperfectly drained soil on first bottoms is derived from mixed alluvium largely of limestone origin or strongly influenced by limestone. It is widely distributed over the county along a great many of the creeks (pl. 9, *B*) that flow through areas underlain by limestone or interbedded limestone and shale. Areas also occur along the Holston River. The surface is nearly level. Practically all areas are subject to flooding, although those along the Holston River are now partly protected by a flood-control dam upstream.

Profile description:

0 to 8 inches, brown or pale-brown silt loam.
8 to 20 inches, brown silt loam with some mottlings of gray and yellow.
20 inches+, mottled gray, yellow, and some brown heavy silt loam or silty clay loam; limestone or shale bedrock at widely variable depths—in places at less than 5 feet and in others as much as 35 or 40.

In places there is a dark-brown silt loam or silty clay loam layer at depths of 10 to 20 inches. It represents an older surface layer that has been buried by more recent floodwater deposits. A variable amount of chert occurs in a few places, but not enough to interfere materially with cultivation.

This is a fertile soil with a moderate content of organic matter. It ranges from moderately acid to slightly alkaline. Internal drainage fluctuates. The soil is sometimes flooded during the wettest season, but during the drier months the water table is about 3 feet below the surface. The soil is permeable to moisture and roots, although excessive moisture in the subsoil does not encourage root development of some of the deep-rooted plants. The high moisture-holding capacity for plants and the moderate depth to the water table during the drier seasons make this soil particularly favorable for midsummer pasture and for crops requiring abundant moisture late in summer and in fall.

Use and management.—A great part of this soil has been cleared. Some is used for permanent pasture, but a notable part is used for crops, chiefly corn and hay. On many areas corn is grown several years in succession. Little fertilization is practiced, since the occasional flooding aids greatly in maintaining relatively high fertility. Under ordinary conditions corn yields about 45 bushels an acre and pasture has a carrying capacity of about 115 cow-acre-days.

Lindside silt loam is suited to crops requiring tillage, but its range of suitability is limited by slow internal drainage and susceptibility to flooding. It is particularly well suited to permanent pasture, certain hay crops such as lespedeza, timothy, and redtop, and row crops such as corn and soybeans. It can be used intensively for row crops, as its natural fertility is high and runoff is no hazard.

Although this is a fertile soil, it will respond to proper fertilization, especially with phosphorus. In general, weed growth is rank on soils like this one, and adequate weed control will aid in obtaining high yields. Where additional acreage is needed for crops requiring better internal drainage, it may be feasible to improve some areas by artificial drainage.

Where high fertility and adequate drainage are maintained and weeds are eradicated, corn will yield 60 to 65 bushels and lespedeza about 2 tons an acre. Because of high fertility and particularly favorable moisture relations, this soil provides pasture of high quality over a long grazing season. The carrying capacity under good management, which particularly includes adequate fertilization and suppression of weedy and brushy growth, should be about 150 cow-acre-days.

Made land (0–15% slopes) (MA).—This land type occupies areas that have been altered by man-made excavations or depositions and have no agricultural value. It includes fills, dumps, and such excavations as quarries and mines. Some of these areas are in railroad yards and a few are athletic fields. They are rather widely scattered over the county, but most of them are in the vicinity of Knoxville and Mascot. Those in the vicinity of Mascot consist chiefly of refuse from zinc mines.

Melvin silt loam (0–2% slopes) (MB).—This very poorly drained soil on first bottoms was derived from mixed general alluvium. The parent rock for this alluvium apparently was predominantly limestone

or mixed limestone and shale. Most of the soil occurs in tracts 5 to 30 acres in size, mainly along creeks in association with Lindside soils. Most of it occurs on relatively low parts of the bottom lands. A few areas are along drainageways and generally in higher positions than those on the bottom lands along the streams. These areas along intermittent drains are not particularly subject to overflow but are wet most of the time because of seepage waters and retarded surface drainage.

Profile description:

0 to 6 inches, brownish-gray or gray, faintly mottled with brown, silt loam.
6 to 20 inches, mottled gray, yellow, and brown compact and plastic silty clay.
20 inches+, gray plastic silty clay mottled with yellow and brown; limestone or interbedded limestone and shale bedrock at depths ranging from less than 5 feet to 30 or 40 feet; the rock is at shallower depths in areas along the smaller streams.

Some areas have a somewhat browner surface layer. In a few places there is a brown silt loam layer at depths of 6 to 12 inches; this is a former surface layer buried by more recent deposits.

The natural fertility of this soil is moderately low, and the organic-matter content ranges from low to moderate. The reaction is moderately acid to slightly alkaline. Moisture conditions fluctuate greatly. The soil may be flooded during wet periods or have a water table 2 or 3 feet below the surface during the drier ones. Consequently, in some areas plants grow slowly during the wettest season because there is too much moisture and are retarded during the driest parts of the growing season because there is too little. Other areas are permanently moist and favorable for many pasture plants during the driest periods.

Use and management.—Probably half of this soil has been cleared and is used for pasture. Much of the rest is under forest, and a small part is used for crops, chiefly corn and hay. Crop yields are low. The carrying capacity of pasture is about 40 cow-acre-days under ordinary conditions. This soil is not considered well suited to crops requiring tillage. Where it has been improved by artificial drainage, properly fertilized, and seeded, it has a carrying capacity of about 110 cow-acre-days. It may be feasible to drain some areas for such crops as corn and lespedeza. Where this has been done and heavy rates of fertilization are practiced, the soil is suited to relatively intensive use. Its tilth, however, is not favorable and the periods when it can be cultivated are restricted by excess moisture.

Montevallo silt loam, steep phase (25+% slopes) (MG).—This is a grayish shaly soil, shallow to acid shale (pl. 10). It has steep slopes ranging from approximately 25 to 60 percent. It is one of the less extensive of the Montevallo soils. The areas are not large and are practically all in the Montevallo soil association area in the northwestern part of the county.

Profile description:

0 to 5 inches, grayish-yellow or gray silt loam that may include some shale fragments.
5 to 14 inches, brownish-yellow friable shaly silt loam or shaly silty clay loam; gray fissile shale at depths of 12 to 20 inches.

In some places the brownish-yellow friable shaly silt loam or shaly silty clay loam layer is lacking and disintegrated shale material is within a few inches of the surface.

This soil has low natural fertility and contains only a small amount of organic matter. Its reaction is moderately to strongly acid and its capacity for holding either moisture or plant nutrients is low. Practically all of this soil is under native deciduous forest, chiefly oaks, with some other deciduous trees and a few pines intermixed. Because of its low fertility, unfavorable moisture relations, and strong slope, the soil is poorly suited to either crops or pasture and should be used for forest.

Montevallo shaly silt loam, eroded steep phase (25+% slopes) (ME).—This soil covers areas formerly occupied by the steep phase of Montevallo silt loam that have lost a considerable part of their soil material as a result of erosion. It is in the Montevallo soil association in the northwestern part of the county. The surface is steep. Slopes range from about 25 to 60 percent. The surface 4 inches is grayish-yellow to gray shaly silt loam or shaly silty clay loam. Partly disintegrated olive, yellow, brown, and gray shale is below this. In places this shaly material outcrops. There are some gullies, a few of which are too deep to be crossed by farm machinery.

This soil is low in fertility and very low in organic matter and capacity to hold moisture or plant nutrients. As a result it is droughty and supports a sparse plant growth.

Use and management.—All of this soil has been cleared at some time, but much of it is now idle or reforested with pine. Some is pastured but the vegetation is of poor quality and very low carrying capacity. This soil is poorly suited either to crops or pasture, chiefly because of droughtiness, strong slope, and low fertility. It should be used for forest.

Montevallo shaly silt loam, eroded hilly phase (12–25% slopes) (MC).—This grayish shaly soil has acid shale at a very shallow depth. It is one of the predominant soils in the Jefferson-Montevallo and Montevallo soil association. A large part of the acreage has been cleared and cultivated, and as a result much soil material has been carried away by runoff.

Profile description:

0 to 4 inches, yellowish-gray shaly silt loam.
4 to 12 inches, brownish-yellow friable shaly silt loam or shaly silty clay loam; gray fissile shale at depths of 14 to 20 inches.

In many places, especially where erosion has been most active, the partly disintegrated shaly material is within a few inches of the surface, and in some places it outcrops.

This soil has very low natural fertility and organic-matter content and, because of the shallow depth to shaly material, very unfavorable moisture relationships. A great part has been cleared but much of it is now idle or used as unimproved pasture. Grazing vegetation is sparse and of low quality. The predominant vegetation consists of brushy growth with some broomsedge and lespedeza intermixed.

Because of its strong slope and shaliness, the soil has poor workability and is difficult to conserve or to build to a moderate state of productivity. It is not considered suited to either crops or pasture; its best use is for forest. Shortleaf pine and Virginia pine are among the better suited trees for reforestation.

Montevallo shaly silt loam, eroded rolling phase (5–12% slopes) (MD).—This soil differs from Montevallo silt loam, steep phase, chiefly in its smoother slope and loss of part of its original surface layer through erosion. Also, the soil material over the partly disintegrated shale is generally a little deeper. There are a few small gullies locally but most of them can be obliterated by tillage. This phase is widely distributed throughout the Jefferson-Montevallo and Montevallo soil associations and is one of the more extensive of the Montevallo soils.

The surface layer, which may be 4 or 5 inches thick, is grayish-yellow shaly silt loam. Below this may be brownish-yellow shaly silt loam or shaly silty clay loam that continues to depths of 12 to 14 inches. Underlying this material is olive-yellow, brown, and gray partly disintegrated shale. Beds of olive-gray fissile shale are within 16 to 40 inches of the surface. In places the brownish-yellow shaly silty clay loam material is lacking, and here the partly disintegrated shale is within a few inches of the surface and may outcrop in the more eroded spots. On the other hand, in the smoother parts this brownish-yellow layer may be 12 or 14 inches thick and the partly disintegrated shale 16 to 20 inches below the surface.

The natural fertility and organic-matter content of this soil are low. The reaction is moderately to strongly acid. Internal drainage is medium. The capacity of the soil to hold plant nutrients and moisture available to plants ranges from moderate to very low, depending upon the thickness of the layers of shaly silt loam and silty clay loam.

Use and management.—A great part of this soil has been cleared and used for crops. At present some has reverted to idle land or has been reforested by natural means with shortleaf pine. A notable part is used for permanent pasture. Most of the pasture is of low carrying capacity, but some well-managed areas are supporting good vegetation. Some parts are cropped, predominantly to hay, small grains, and corn. A little fertilizer is applied, and much of the acreage has been limed recently.

This soil is not well suited to crops requiring tillage because it has moderately strong slope, low fertility, and shallow depth to shale bedrock. Long rotations consisting chiefly of hay and pasture and fall-sown small grains are necessary for the proper conservation of areas required for crops. Heavy applications of fertilizer and additions of organic matter and lime are necessary to establish good stands of grasses and clovers. The deeper parts of the soil may support alfalfa if the fertility is brought to a high level. Under the best management, oats will yield about 22 bushels and lespedeza about 0.9 ton an acre. If pasture of good quality is established, a carrying capacity of 50 cow-acre-days can be expected. The grazing season is usually rather short because the soil has limited moisture-holding capacity. Vegetation ceases to grow luxuriantly early during the drier seasons.

Montevallo shaly silt loam, eroded undulating phase (2–5% slopes) (MF).—This is a grayish shaly soil relatively shallow to acid shale bedrock. It differs from the eroded rolling phase chiefly in having a smooth surface. The plow layer in most places consists of a mixture of grayish-yellow silt loam surface soil and subsoil material.

It is underlain by brownish-yellow shaly silt loam or shaly silty clay loam. Partly disintegrated olive-yellow, brown, and gray acid shale is at depths of 10 to 24 inches, and weathered olive-gray fissile shale is at depths of 15 to 40. The amount of erosion varies greatly. The small acreage still under forest is the least eroded and the more sloping intensively cropped parts the most eroded. In the severely eroded spots, the partly disintegrated shale may be at the surface.

The natural fertility and content of organic matter is low and the reaction is moderately to strongly acid. The capacity for holding moisture available to plants is moderate where the soil material is thickest over the shale but very low where the shale is within a few inches of the surface. These shallow areas are very low in natural fertility.

Use and management.—A great part of the acreage has been cleared and used for crops. Some is now idle and parts have reverted to shortleaf pine forest. On the cropped acreage, corn and hay predominate and lespedeza is the chief hay crop. Under ordinary conditions only light fertilization is practiced, but some lime has been applied to much of the acreage. Crop yields generally are low and the pasture vegetation is of relatively poor quality. In most places it consists of broomsedge and some lespedeza with smaller amounts of other grasses intermixed.

This soil is considered suitable for crops requiring tillage; but as for the eroded rolling phase, management requirements are exacting. Organic matter, plant nutrients, and lime are required if moderate productivity is to be obtained. Small grains, hay, and pasture are the better suited crops, although row crops such as corn can be grown at infrequent intervals. The shallow depth to shale causes much of the acreage to be droughty; consequently, plant growth during the drier parts of the growing season is greatly restricted. As with the other Montevallo soils, tilth is not favorable because a great part of the plow layer consists of shaly material. This material, however, is easily disrupted, and if improved areas are desired for crop production, deep plowing or subsoiling seems practical. Under good management oats will yield about 25 bushels and lespedeza 1 ton an acre. The carrying capacity of well-established pasture can be expected to be 55 cow-acre-days.

Muskingum stony fine sandy loam, steep phase (25+% slopes) (Mn).—This is a steep stony soil shallow to bedrock of sandstone or interbedded sandstone and acid shale. The slopes range chiefly from 30 to more than 60 percent but in a few small areas from 12 to 30 percent.

Profile description:

0 to 6 inches, brownish-gray stony fine sandy loam.
6 to 12 inches, light-yellow friable stony fine sandy loam or stony sandy clay loam, underlain by acid sandstone bedrock or interbedded sandstone and shale.

The thickness of the soil material over the bedrock varies. In some places it outcrops, whereas in a few it may be at a depth of 2 feet.

The natural fertility and the content of organic matter are low and the reaction is strongly acid. The capacity for holding moisture available to plants is low.

Nearly all of this soil is under native mixed hardwoods and pines. A small acreage is used for pasture. Because of its shallow depth to bedrock and strong slope, this soil is poorly suited to either crops or pasture. It may be feasible to establish pasture on a few of the more favorable sites, such as on north-facing slopes and in coves. In general, forest is the best use.

Muskingum-Lehew fine sandy loams, steep phases (25+% slopes) (Mm).—This complex of soils makes up a notable part of the Muskingum-Lehew soil association. It is shallow to bedrock of acid shale or acid sandstone. The Muskingum parts consist of a shallow soil over brownish-yellow sandstone or sandy shale, whereas the Lehew parts are shallow soil over predominantly dusky red or weak-red acid sandy shale. Slopes range from 25 to about 60 percent.

Profile description of the Muskingum soil:

0 to 6 inches, brownish-gray fine sandy loam grading to light-yellow friable sandy clay loam or heavy fine sandy loam at about 5 inches; brown acid sandstone is at depths of 6 to 24 inches; sandstone fragments are common throughout the entire profile; some sandstone outcrops.

Profile description of the Lehew soil:

0 to 6 inches, grayish-brown to weak-red fine sandy loam or very fine sandy loam.

6 to 12 inches, light-brown or weak-red friable sandy clay loam or loam underlain by weak-red or dusky-red acid shale; in places the shale is within a few inches of the surface.

The soils of this complex are low in fertility and organic matter and moderately to strongly acid. The shallow depth to bedrock causes the soils to have a low capacity for holding either moisture or nutrients for plants. What soil material there is, however, has good permeability to both roots and moisture.

Use and management.—A great part of this complex is under cutover mixed hardwood and pine forest. Some small areas are cleared and used for pasture or crops. The pastures consist chiefly of lespedeza, broomsedge, and redtop with a small amount of bluegrass and white clover intermixed. Little fertilization is practiced, and lime has not been applied to any great extent to cultivated areas. Crop yields generally are low.

Strong slope, low fertility, and shallow depth to bedrock make these soils poorly suited to either crops or pasture. The more favorable sites, however, can be made to produce some pasture if they are adequately limed and fertilized and properly seeded. The carrying capacity is low, however, and under average conditions this complex is best used for forest.

Muskingum-Lehew fine sandy loams, eroded steep phases (25+% slopes) (Mk).—This complex comprises areas of Muskingum-Lehew fine sandy loam, steep phases, that have lost a notable part of the soil material through erosion. Some gullies occur but most of them are shallow and can be obliterated either by deep tillage or filling.

The few inches of surface soil is brownish-gray (Muskingum) or weak-red (Lehew) fine sandy loam containing a variable amount of sandy shale fragments. It is underlain by shale beds. In places these beds outcrop. The slope ranges from about 25 to 60 percent.

The natural fertility and content of organic matter are very low and the reaction is strongly acid.

These soils are droughty and difficult to till, chiefly because of strong slope and stoniness. They are not considered suitable for crops requiring tillage or for pasture. Under most circumstances they are best used for forest.

Muskingum-Lehew fine sandy loams, hilly phases (12–25% slopes) (ML).—This complex of hilly soils is shallow to bedrock of acid shale. Most of it occurs on foothills directly below the ridges of steep Muskingum-Lehew soils. It is associated with the Jefferson and Montevallo soils. Areas occur mainly along the northwestern edge of the Jefferson-Montevallo soil association and adjacent to the Muskingum-Lehew soil association. The parent rock is variable. Some of it is dusky-red acid shale with some sandy streaks that gives rise to the Lehew soil, and other parts consist of variegated brown, yellow, and gray shale that gives rise to the Muskingum soil. For the most part the complex has an irregular thin covering of loamy or sandy loam colluvium that has sloughed down from the higher lying Muskingum-Lehew soils. Most of this complex consists of the Muskingum member.

Profile description of the Muskingum soil:

0 to 6 inches, brownish-gray fine sandy loam or loam containing some small angular sandstonelike fragments.
6 to 12 inches, brownish-yellow friable fine sandy clay loam or loam.
12 inches +, partly disintegrated streaked or variegated brown, yellow, and gray shale with considerable clayey material intermixed; shale bedrock at depths of 12 to 36 inches.

In those areas of the complex occupied by the Lehew soil, the surface layer is weak-red fine sandy loam or very fine sandy loam and the subsoil is light-brown or weak-red friable clay loam or loam. The quantity of sandstonelike fragments varies, but only in a few places are there enough to prohibit tillage.

These hilly phases are low in organic matter and plant nutrients and strongly acid. The soil material is permeable, but because of the shallow depth to shale bedrock, the capacity for holding moisture is limited and runoff develops rapidly during rains.

Use and management.—Practically all of this complex is under cut-over forest. The soils are not well suited to crops requiring tillage or pasture, chiefly because of the shallow depth to bedrock, strong slope, and low fertility. If better suited soils are lacking, however, these can be cropped and pastured with a fair degree of success. They are capable of producing fair yields of small grains and hay crops, but management requirements are very exacting if these soils are to be properly conserved.

Proper management for crops requires that fertility be increased and maintained and that the surface be kept covered most of the time by vegetation. Where improved productivity is maintained, wheat will yield 15 bushels and lespedeza 1.1 ton an acre. Where adequate fertilization and liming are practiced, such pasture plants as lespedeza, redtop, and orchard grass have a carrying capacity of about 45 cow-acre-days. A good stand of the more exacting legumes and grasses is more difficult to maintain, however, since they require rela-

tively high fertility. Even when this soil is under pasture, care is required to maintain a plant cover adequate to restrain erosion.

Muskingum-Lehew fine sandy loams, eroded hilly phases (12–25% slopes) (MH).—This complex occupies areas, formerly of the hilly phases of Muskingum-Lehew fine sandy loams, that have lost considerable soil material through erosion. It is widely distributed along the northwestern edges of areas of the Jefferson-Montevallo soil association where they are adjacent to areas of the Muskingum-Lehew soil association. Like the hilly phases of Muskingum-Lehew fine sandy loams, these phases are closely associated with the Montevallo and Jefferson soils. The surface layer of some of the more eroded areas of the Muskingum soil is brownish yellow, and that of the Lehew soil is finer textured than a fine sandy loam. In many of the more eroded parts, however, shaly material outcrops.

The natural fertility and organic-matter content of this complex are low and the reaction is strongly acid. Tilth is unfavorable, chiefly because of the shallow depth to shale. The moisture-holding capacity is small; consequently, the soils are droughty.

Use and management.—All of this complex has been cleared and cropped at some time. A great part is now either idle or used as unimproved permanent pasture. Broomsedge is the predominant vegetation suitable for grazing. Many areas have a variable brushy cover consisting of sassafras, briers, and other shrubby growth.

These soils are poorly suited to crops requiring tillage. If adequate fertilization and other good management are practiced, a long rotation consisting chiefly of close-growing small grains and hays can be followed in many places without rapid deterioration of the soil. Fair pasture can be maintained, where fertilization and proper seeding have been practiced, but the droughty soil limits plant growth, especially during the drier parts of the growing season.

Neubert loam, undulating phase (2–5% slopes) (NB).—This is a well-drained, dark-red loamy soil consisting of local alluvium from Tellico soils. It occupies lower foot slopes and strips of local alluvium along drainageways leading from the higher areas of Tellico soils. All of it is within the Tellico-Neubert soil association.

Profile description:

0 to 12 inches, reddish-brown loam or fine sandy loam.
12 to 36 inches, brownish-red friable clay loam; calcareous sandstone or shale bedrock at widely variable depths ranging from about 3 to 20 feet.

This is a moderately fertile soil containing a moderate amount of organic matter. It ranges from slightly to moderately acid. Internal drainage is moderate. It is an exceptionally permeable soil and has a fairly high capacity for holding moisture available to plants, which together with its low lying position, give it particularly favorable moisture relations for most crops commonly grown.

Use and management.—A great part of this soil is cleared and used for corn, small grains, lespedeza, tobacco, truck crops, and hay. Practically all of it receives some fertilization and much has been limed. Those areas used for truck crops and tobacco receive heavy fertilization. Rather short rotations are common. Under ordinary conditions corn yields about 42 bushels and tobacco 1,600 pounds an acre.

This is among the most desirable soils of the county for crops requiring tillage. It is moderately productive and easily worked and conserved, although some care is required to restrain runoff on the more sloping parts. It is suited to moderately short rotations and particularly well suited to early truck crops, tobacco, and corn. Small grains and hay produce well also, but some experience indicates that alfalfa stands are somewhat more difficult to maintain several years than on some of the more fertile soils with firmer subsoils. Lime is especially required for legumes. Where high fertility is maintained, corn will yield 63 bushels, lespedeza 1.9 tons, and tobacco about 2,100 pounds. Pasture plants do well on this soil, as moisture relations are exceptionally favorable. Where fertility and lime requirements are met, the more desirable legumes and grasses ordinarily maintain a carrying capacity of about 145 cow-acre-days.

Neubert loam, rolling phase (5–16% slopes) (NA).—The rolling phase differs from the undulating phase chiefly in having stronger slopes; the gradient ranges from 5 to 20 percent, although most slopes fall between 5 and 16. The soil is widely distributed throughout the Tellico-Neubert soil association. Most of it occurs on lower foot slopes or as narrow strips along drainageways in areas of Tellico soils.

Like the undulating phase, it is relatively fertile and has a moderate organic-matter content. It is permeable to both roots and moisture and has good capacity for holding moisture available to plants. Its position on the lower slopes and along the drainageways gives it favorable moisture relations, and it is much less subject to drought than the associated soils.

Use and management.—A great part of this soil is cleared and now used for crops, chiefly corn, small grains, hay, tobacco, and truck crops. It is well suited to crops requiring tillage, but because of its greater slope, it requires somewhat longer rotations than the undulating phase. It is suited to a wide variety of crops, including corn, small grains, practically all hay crops, and tobacco and vegetables. Some special care is required to restrain erosion, but runoff is less hazardous than on many of the soils having a more compact subsoil. Where fertility is maintained at a high level, corn should yield about 60 bushels, alfalfa about 3.3 tons, and tobacco about 2,000 pounds an acre. Under good management this soil is well suited to the more desirable pasture grasses and legumes. As for the undulating phase, the grazing season is relatively long because pasture plants do not suffer from lack of moisture as soon as they do on many of the associated soils.

Nolichucky gravelly loam, eroded rolling phase (5–12% slopes) (NC).—This phase occurs on high stream terraces and occupies approximately the same position as the eroded rolling phase of Waynesboro loam. It differs from the Waynesboro soils chiefly in having a grayer surface and a subsoil of weaker red color. Since practically all areas have been more or less eroded, the plow layer consists of the original surface material and some subsoil intermixed. Although the areas of this soil are not numerous, they are widely scattered along the Holston, French Broad, and Tennessee Rivers. Separate tracts range from 10 to 40 acres in size.

Profile description:

0 to 6 inches, very pale-brown or gray gravelly fine sandy loam or loam.
6 to 20 inches, reddish-yellow firm but friable fine sandy clay loam.
20 inches +, reddish-yellow, with yellowish-gray streaks, firm but brittle fine sandy clay; intermittent gravelly bed at depths of 48 to 60 inches and shale or limestone bedrock at depths ranging from approximately 5 to 40 feet.

In places there is but little gravel intermixed in the surface layer, but in most areas gravel is abundant enough to interfere somewhat with cultivation. In some places the subsoil lacks the reddish cast and is nearly yellowish brown or brownish yellow. Some areas along the French Broad River have purplish or weak-red shaly material at depths ranging from 2 to 3 feet.

The natural fertility and content of organic matter are low. The reaction is moderately to strongly acid. Internal drainage is moderate, and the soil is permeable to both roots and moisture. The capacity for holding moisture available to plants is fair to good.

Use and management.—A great part of this soil has been cleared and is now used for crops, chief of which are corn, lespedeza, small grains, and some vegetables and tobacco. There is a small acreage of alfalfa. Light fertilization is practiced, and lime has been applied to much of the soil. Moderately short rotations are used. Under ordinary conditions corn yields about 20 bushels and lespedeza about 0.7 ton an acre.

This soil is suited to crops requiring tillage, but its low fertility, rolling surface, and gravelly nature make it less so than many soils. It is moderately well suited, however, to a wide variety of crops. Where adequate fertilization, including application of organic matter and lime, has been practiced, corn will yield about 42 bushels, wheat 19 bushels, and lespedeza 1.4 tons an acre. Moderately long rotations and some special care to control runoff are necessary if productivity is to be maintained. Where adequate liming and fertilization have been practiced and pasture grasses have been properly seeded, the carrying capacity is about 95 cow-acre-days. The more desirable legumes and grasses, such as white clover and bluegrass, are difficult to grow unless high fertility is maintained.

Ooltewah silt loam (0–2% slopes) (Oa).—This is a brown friable imperfectly drained soil consisting of local alluvium. It occupies nearly level saucerlike depressions in landscapes consisting of soils developed over limestone. The soil material accordingly has been washed from soils of this group. Ooltewah silt loam resembles the Abernathy in position and source of parent material, but differs in having slower internal drainage. It is not an extensive soil. The separate areas are small. In great part they are associated with Decatur and Dewey soils and to less extent with the Fullerton, Talbott, Farragut, Colbert, and Sequoia.

Profile description:

0 to 10 inches, brown to grayish-brown friable silt loam.
10 to 18 inches, yellowish-brown friable silty clay loam.
18 inches +, mottled-gray, yellow, and brown firm silty clay loam; limestone bedrock at widely variable depths ranging from 10 to 30 feet.

In some places this soil represents areas of Guthrie silt loam on which the Ooltewah soil material has been deposited since cultivation

of the surrounding land. Here the surface layer, to depths ranging from 8 to 14 inches, is grayish-brown or brown silt loam; directly below this is light-gray silt loam. Gray compact stiff silty clay mottled with yellow and brown is at depths of 18 to 28 inches. The color of the surface layer of Ooltewah silt loam varies notably and generally correlates with the color of the surface layer of the surrounding soils from which the soil material has washed. Accordingly, those areas associated with the Fullerton soils are relatively light-colored, whereas those associated with the Dewey, Decatur, and Farragut soils are relatively dark. The darker colored areas are the more fertile.

This soil is normally moderately acid, although some areas are slightly acid. The natural fertility is medium to high. Most areas have little or no surface drainage. Although internal drainage is slow, the soil material is actually quite permeable to depths of 2 to 5 feet or more. The water table fluctuates from a ponded condition during the wettest periods to 2 to 4 feet or more below the surface during the driest periods. Those areas having some kind of surface drainage outlet are infrequently ponded, whereas those occupying sinkholes with no drainage outlet may be ponded for several weeks during the wettest season and at least for several days following heavy summer rains.

Use and management.—A very great part of this soil is cleared. About half is used for corn and the rest chiefly for grasses and legumes for hay and pasture. Little fertilization is practiced and legume cover crops to be turned under are seldom grown. Under ordinary conditions corn yields about 45 bushels. Pastures generally consist of bluegrass, Bermuda grass, and some lespedeza and white clover. The carrying capacity is 115 cow-acre-days, or moderately high.

High fertility, smooth surface, and favorable moisture relations make this soil particularly well suited to corn, certain hay crops, and pasture. It is productive of other crops also, but its susceptibility to ponding makes growing of fall-sown small grains and high-value crops such as tobacco rather hazardous. Moisture relations are especially favorable for pasture late in summer. The soil is therefore particularly valuable at that time as grazing land to supplement pasture on more droughty soils. Some areas have been improved for crops by artificial drainage and nearly all of it could be improved for this purpose. Whether or not artificial drainage is practical will depend on the size of the area, the cost of installation, the need for additional acreage of better drained soil on the farm, and other factors.

Where drainage is adequate and some fertilization is practiced, corn should yield about 63 bushels and lespedeza hay about 2 tons an acre. Well established bluegrass, white clover, and orchard grass pasture, free of weeds and brushy growth, will yield about 145 cow-acre-days of grazing under favorable conditions.

Prader silt loam (0–2% slopes) (Pa).—This is a gray very poorly drained soil on first bottoms or flood plains along the creeks. It is in those areas where the alluvium originated predominantly from shales

and sandy shales, which are in notable part rather acid, or free of lime. The separate areas are rather small and occupy the nearly level low parts of the bottom lands that are most subject to overflow.

Profile description:

0 to 10 inches, gray, slightly mottled with yellow, loam or silt loam.
10 to 40 inches, somewhat darker gray, mottled with yellow and brown, firm to compact clay loam or clay; shale bedrock at depths of 5 to 30 feet.

The texture of the surface layer ranges from fine sandy loam to silt loam. In places there are beds or thin layers of very sandy material. Sandstone cobbles or fragments are sufficiently abundant in a few areas to interfere somewhat with tillage.

The natural fertility and organic-matter content are low. The reaction ranges from neutral to medium acid. The soil may be ponded during periods of heavy rainfall or the water table may be 2 to 4 feet below the surface during the drier seasons. Permeability also varies. Permeability is moderately rapid in the more sandy parts but very slow where the subsoil is compact silty clay.

Use and management.—Most of this soil has been cleared and is now used for hay or pasture. A small acreage is still forested. Redtop and wild grasses and sedges make up a great part of the pasture growth. Little or no fertilization is practiced but many areas have been drained by ditches. Areas in which this drainage operates effectively are used for corn, sorghum, and lespedeza. Pasture, ordinarily not of high quality, has a carrying capacity of about 40 cow-acre-days. There are some marshy areas, which in their natural state are of low value even for pasture. Many of the wetter areas are indicated on the soil map by symbol.

Under natural conditions this soil is not suited to crops requiring tillage, but it can afford fair to good grazing. If drainage is improved and good pasture plants are established, a carrying capacity of about 100 cow-acre-days can be expected. Where artificial drainage is effective and heavy fertilization is practiced, such crops as corn, lespedeza, sorghum, and soybeans are well suited. Crops such as tobacco, alfalfa, and truck crops cannot be expected to produce well. Moreover, the flood hazard is too great to justify raising high value crops such as tobacco.

Under a high level of management, corn will yield about 38 bushels and lespedeza hay about 1.8 tons an acre. With artificial drainage and improved tilth, moisture relations on the more favorable areas will be particularly desirable for pasture during the drier parts of the grazing season.

Roane silt loam (0–2% slopes) (RA).—This is a moderately well drained soil on some of the smaller creek bottoms in the more cherty parts of the cherty ridge lands. It consists of material washed chiefly from Clarksville soils. A great part is closely associated with Clarksville soils of the Fullerton-Bolton-Clarksville soil association. The surface is nearly level and parts are subject to overflow. Nevertheless, the Roane soils are generally less subject to inundation than many others of the bottom lands, such as those of the Lindside and Hamblen series.

Profile description:

0 to 8 inches, gray to grayish-brown friable silt loam containing chert gravel up to 3 or 4 inches in diameter.
8 to 20 inches, yellowish-brown or yellowish-gray friable silty clay loam containing some chert gravel.
20 to 30 inches, firm or tightly embedded cherty material with mottled-gray and brown silty clay loam; limestone bedrock at depths of 4 to 15 feet.

Some areas are so cherty that tillage is impractical. In some places the subsoil material is looser and more permeable.

The natural fertility and content of organic matter are low, and the reaction is medium to strongly acid. Most areas are notably droughty; consequently, crops suffer from lack of moisture early during drier parts of the growing season. The permeability of the subsoil varies according to the degree of firmness or tightness of the material at depths of 20 to 30 inches.

Use and management.—Much of this soil is cleared. The forested parts are confined to the smaller less accessible areas on the narrower creek bottoms flanked by steep slopes of Clarksville soils. The cultivated areas are used chiefly for corn, but a notable part is used for hay and pasture. Fertilization is not heavy and the crop yield generally is rather low. Corn averages about 30 bushels and lespedeza 1 ton an acre. Under ordinary conditions pasture is not of high quality; its carrying capacity is greatly limited by the low fertility and droughtiness of the soil.

If adequately fertilized, this soil is suited to tilled crops grown in relatively short rotations. Its smooth surface and the permeability of the first 18 to 24 inches make runoff fairly easy to control. Corn, small grains, hay, and pasture are among the better suited crops. The chertiness of the soil and the commonly meandering well-entrenched stream channels, however, interfere with cultivation, mowing, and reaping in many places.

If good yields are to be obtained, much organic matter and lime and heavy applications of nitrogen, phosphorus, and potash fertilizers are required. Where a high level of management is practiced, corn will yield about 50 bushels, wheat 23 bushels, and lespedeza 1.7 tons an acre. Pasture of high quality is more difficult to maintain than on some of the more fertile soils, such as those of the Emory and Dewey series. Where the soil is adequately limed, fertilized, properly seeded, and otherwise well managed, pasture with a carrying capacity of about 110 days can be expected.

Sequatchie fine sandy loam (2–12% slopes) (Sa).—This is a light-brown sandy soil on low stream terraces along the Holston, Tennessee, and Clinch Rivers. The separate areas, 10 to 40 acres in size, are widely distributed along these rivers. They are undulating to rolling and few of them lie more than 20 feet above the adjacent bottom lands.

Profile description:

0 to 10 inches, pale-brown to grayish-brown loose fine sandy loam.
10 to 18 inches, yellowish-brown or brownish-yellow friable fine sandy clay loam.
18 to 36 inches, brownish-yellow friable fine sandy clay loam that in many places becomes more sandy with depth; bedrock at widely variable depths ranging in most places between 10 and 40 feet.

A few areas on the higher stream terraces have a more loamy brownish-gray surface soil, and the material below a depth of 30 inches is firm sandy clay loam or clay loam streaked or moderately mottled with yellow, brown, and gray. On some of the lowest stream terraces the surface layer is darker than ordinary and the soil material below a depth of about 20 inches is mottled yellow, brown, and gray clay loam. There are also several areas where the entire soil is notably sandy; the surface 8 or 10 inches is yellowish-gray loamy fine sand and the subsoil is light-yellow loamy fine sand grading to sand at a depth of about 28 inches.

This soil is moderately fertile, although rather low in organic matter, and medium to strongly acid. Except for low areas that are mottled at 20 to 22 inches, all of the acreage is permeable to both roots and moisture. The low areas have somewhat retarded internal drainage and unfavorable permeability to roots. Internal drainage is generally moderate, however, and favorable to most crops commonly grown. The more sandy areas have very rapid internal drainage and a limited capacity for holding moisture available to crops. Elsewhere the moisture-holding capacity is at least moderately good.

Use and management.—Practically all of this soil has been cleared and a great part is used for crops, chief of which are corn, legume-and-grass hay, vegetables, and small grains. Some fertilizer is used, especially for the truck crops, and short rotations prevail. Row crops are grown on some areas several years in succession. Under ordinary conditions corn yields about 35 bushels, alfalfa 2.5 tons, and tobacco 1,400 pounds.

A smooth surface, good permeability, and good response to proper fertilization make this soil well suited to crops. Because it is sandy, it is somewhat less desirable for bluegrass and similar permanent pasture crops than some of the more fertile silt loam soils. Short rotations are suitable; and except on the most sandy areas, high value row crops such as tobacco and vegetables are particularly desirable. Although its natural fertility is not high, the soil responds well to fertilization. Substantial applications of plant nutrients and organic matter are required to produce high yields. Moderate applications of lime are needed for most of the crops commonly grown, especially the legumes and the more desirable grasses.

Where good management is practiced, corn will yield 55 bushels an acre. Good pasture has a carrying capacity of about 110 cow-acre-days. The more sandy areas cannot be expected to produce this well, since the more desirable pasture plants are difficult to maintain. In general, small but frequent applications of fertilizer are more practical for the more sandy areas, and such crops, as corn, melons, and early spring vegetables are particularly suited to them.

Sequoia silt loam, undulating phase (2–5% slopes) (SH).—Like other Sequoia soils, this is a moderately deep soil on the undulating uplands underlain by calcareous shale and interbedded shale and limestone. It has the characteristic brownish-gray surface layer and reddish-yellow subsoil underlain by shaly material.

This phase is on the smoother areas that have been relatively uneroded and is almost all under native deciduous forest. It is associated with other Sequoia soils, chiefly in the Sequoia-Leadvale, the Sequoia-Litz-Dandridge, and the Dandridge-Litz-Leadvale soil associations.

Profile description:

0 to 6 inches, brownish-gray silt loam.
6 to 14 inches, brownish-yellow firm silty clay loam.
14 to 20 inches, reddish-yellow or yellowish-brown very firm silty clay that easily breaks from place into nut-sized fragments.
20 inches +, mottled yellow, red, and gray, firm silty clay; soft variegated brown, yellow, and gray shale at depths of 1½ to 3½ feet.

In a few places the surface soil is grayish brown rather than brownish gray, and in some spots the depth to the soft shale is less than 12 inches. The underlying bedrock is free of carbonates to a depth of 5 feet in many places, but in others the carbonates may be within 3 feet. In some areas there are thin interbeds of limestones, which commonly outcrop on the adjacent more sloping Sequoia soils. A few small areas have an olive-yellow plastic clay subsoil underlain by shaly limestone. These are patches of Colbert soil too small to be shown separately on the map.

The natural fertility and organic-matter content are moderate to low. The reaction is medium acid. Internal drainage is moderate to moderately slow, as the firm subsoil somewhat retards infiltration of moisture. The capacity to hold moisture available for crops is fairly good. The soil is somewhat less favorable to root penetration than many of those deeper to bedrock, especially the more permeable soils on stream terraces and well-drained bottoms.

Use and management.—Practically all of this soil is under forest (pl. 11, *A*). Its smooth surface, moderate fertility, and fairly favorable moisture relations make it well suited to tilled crops. Where good management is practiced, 3- or 4-year rotations are practical. Corn, small grains, alfalfa, tobacco, and other crops commonly grown produce fairly well. The soil is not so productive as the undulating phases of the Dewey and Decatur soils but it responds well to proper fertilization. The more sloping parts require some special attention if runoff is to be controlled, as infiltration is not rapid enough to take care of moderately heavy prolonged rains. Legumes and grasses for hay and pasture produce well where proper fertilization, liming, and seeding have been practiced. Under a high level of management corn will yield about 42 bushels, oats 48 bushels, and alfalfa about 3 tons an acre.

Sequoia silty clay loam, eroded undulating phase (2–5% slopes) (SL).—This soil is made up of areas formerly occupied by the undulating phase of Sequoia silt loam. Erosion has removed soil material, so the plow layer consists partly of subsoil material. From 50 to 75 percent of the surface layer has been removed from more than half the area, and the plow layer now consists of grayish-yellow heavy silt loam or silty clay loam. The subsoil is predominantly reddish-yellow very firm silty clay. Soft shale beds are at depths of 1 to 3 feet. Like the undulating phase, this soil has developed over interbedded shale and limestone or calcareous shale and occupies undulating low ridge tops in the Sequoia-Leadvale (pl. 11, *B*), Sequoia-Litz-Dandridge, and Dandridge-Litz-Leadvale soil associations. It is a fairly extensive soil, especially in the Sequoia-Leadvale soil association.

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Use and management.—All of this soil has been cleared and cropped. The principal crops are corn, wheat, oats, lespedeza, redtop, and alfalfa. Tobacco and vegetables are also grown. Pasture occupies a notable part. Under ordinary conditions 2- to 4-year rotations prevail. Corn commonly receives 100 to 150 pounds an acre of 20-percent phosphate or its equivalent, or 0–10–4 or 2–10–2 fertilizer. Tobacco and vegetables receive heavy applications of manure supplemented with 250 to 500 pounds an acre of 2–8–4, 3–8–5, 2–10–2, or 2–10–4. Where alfalfa is to be seeded, 2 or 3 tons of lime and 200 to 500 pounds of 20-percent phosphate or 2–10–4 an acre are applied at seeding time. Light applications of phosphate fertilizer are commonly made each year or so thereafter. Where manure is available, moderate applications are used with the commercial fertilizer in starting the alfalfa. A large part of this soil is treated with 2 to 3 tons of lime once in 6 to 10 years where legume hay crops are commonly grown. Under ordinary conditions corn yields about 22 bushels, wheat 13 bushels, and alfalfa about 2.2 tons an acre.

Its smooth surface, moderately favorable moisture relations, and responsiveness to fertilization, make this soil well suited to cropping. Rotations lasting 3 to 4 years are satisfactory. The more sloping parts require some special attention to restrain runoff, as the slow rate of infiltration causes runoff water to accumulate quickly during rains. Moderately heavy fertilization is necessary, as the natural fertility is not high and the organic-matter content is rather low. Lime is required, especially where legumes are to be grown.

The moderately shallow depth to the silty clay subsoil makes this soil less well suited to many of the truck crops commonly grown than the more permeable fertile soils. Grasses and legumes can be expected to maintain a good cover if the fertility is brought to a high level. Plant growth on the shallower places, that is, where the subsoil is exposed or nearly exposed, is retarded early during dry periods. Practically all crops commonly grown produce well if a high level of management is practiced. With good management, corn yields 40 bushels, wheat 22 bushels, and alfalfa about 2.7 tons an acre. The carrying capacity of pasture is about 100 cow-acre-days.

Sequoia silty clay loam, severely eroded undulating phase (2–5% slopes) (Sn).—This soil covers areas, formerly of Sequoia silt loam, undulating phase, that have lost practically all of the original surface layer as a result of erosion. There are a few small gullies, most of which can be crossed with farm fachinery. The separate areas, 5 to about 15 acres in size, are associated with other Sequoia soils in the Sequoia-Leadvale, Sequoia-Litz-Dandridge, and Dandridge-Litz-Leadvale soil associations.

The plow layer consists chiefly of reddish-yellow silty clay loam or silty clay. The subsoil, only a few inches from the surface, is mixed red, yellow, and gray firm silty clay with streaks of yellow and red. Variable amounts of soft shale fragments are intermixed with the subsoil. Shale bedrock is dominantly at depths of ½ to 2 feet but it outcrops in places. In a few areas thin layers of limestone outcrop.

The natural fertility is low, the content of organic matter is very low, and the capacity for holding moisture available to crops is small.

The reaction is medium to strongly acid. The plow layer has unfavorable tilth, and percolation of moisture is slow. The soil puddles easily when wet and becomes hard and intractable as it dries.

Use and management.—All of the acreage has been cleared and cropped at some time. A large part is now idle or used as unimproved pasture, and much of this has an uneven growth consisting of sassafras, briers, broomsedge, and some lespedeza and other grasses. A small part is cropped, and a few acres have been improved for permanent pasture. Management varies greatly. In many places row crops are grown for a few years, and the soil is then allowed to lie idle. In others a moderately long rotation is used and the soil is fertilized intermittently. On the cropped acreage, corn, small grains, and mixed legume-and-grass hay predominate. Under average management the yields of crops are low; corn averages about 8 bushels and lespedeza 0.4 ton an acre.

This soil is suitable for crops, but its clayey nature, low fertility, and rather shallow depth to bedrock make management rather exacting. It requires relatively large increments of organic matter, lime, and plant nutrients, and special precautions to control runoff. The poor tilth makes the soil difficult to work and causes unfavorable moisture relations. As a result, crops soon suffer during dry periods. Long rotations consisting chiefly of fall-sown small grains and grasses and legumes for hay and pasture are best. The soil is not at all suited to root crops or crops requiring good tilth.

Under the most favorable management oats will yield about 22 bushels and lespedeza about 0.9 ton an acre. The carrying capacity of well-established pasture is about 60 cow-acre-days. The best grazing is confined to the moister parts of the growing season. Some areas may be better adapted to forest. Shortleaf and loblolly pines are among the trees more suitable for reforestation.

Sequoia silt loam, rolling phase (5–12% slopes) (SG).—This rolling phase is similar to the undulating phase except it is more strongly sloping, has a thinner surface layer, and is a little less deep to shale bedrock. The separate areas are few and not very large. They are widely scattered throughout the Sequoia-Leadvale, Sequoia-Litz-Dandridge, and the Dandridge-Litz-Leadvale soil associations.

The surface 5 to 6 inches is brownish-gray silt loam. The underlying material, to a depth of 10 or 12 inches, is brownish-yellow firm silty clay loam. Below this and continuing to a depth of about 16 inches is reddish-yellow or yellowish-brown very firm silty clay. Underlying is firm silty clay streaked or mottled with yellow, red, and gray. Soft variegated brown, yellow, and gray shale is at depths of 1½ to 2½ feet. In a few places the subsoil is olive-yellow plastic clay underlain by shaly limestone. On the more sloping and exposed parts, the subsoil is within a few inches of the surface, and in extreme cases the depth to bedrock may not be more than 10 inches.

The natural fertility and content of organic matter are moderate to low. The reaction is medium acid. Internal drainage is moderate to moderately slow, as the firm subsoil somewhat retards movement of moisture. The capacity of this soil to hold moisture for crops is fair. The soil is less favorable to root penetration than many of the soils deeper to bedrock. Nevertheless, root penetration is fair.

Use and management.—Practically all of this soil is forested. It occupies areas that have never been cleared and cultivated and therefore has not been subjected to erosion. The soil is fairly well suited to cultivated crops. It is moderately productive and not particularly hard to work. The slow percolation and moderately strong slope are conducive to erosion, however, especially on tilled areas. Since it is susceptible to erosion, the soil needs long rotations that include close-growing small grains and grasses and legumes for hay and pasture. Where feasible, field work should be done on the contour. Subsoiling and strip cropping may also be practical ways of restricting erosion. Adequate applications of fertilizer, organic matter, and lime are required if yields are to be kept high. Under good management corn will yield 38 bushels and alfalfa about 2.8 tons an acre. Under favorable conditions the carrying capacity of well-established pasture will be about 100 cow-acre-days.

Sequoia silty clay loam, eroded rolling phase (5–12% slopes) (Sk).—This soil differs from Sequoia silt loam, undulating phase, chiefly in its stronger slope and its loss of a considerable part of the original surface soil through erosion. It is one of the most extensive of the Sequoia soils and occupies much of the Sequoia-Leadvale soil association (pl. 11, *B*). A considerable acreage is also in the Sequoia-Litz-Dandridge and the Dandridge-Litz-Leadvale associations. The separate areas range from 10 to 60 acres in size.

The plow layer consists of a mixture of the original surface soil with some subsoil material; ordinarily it is a brownish-yellow silty clay loam. In spots practically all the surface soil has been lost and the plow layer consists of reddish-yellow very firm silty clay. The surface is rolling but small smoother areas are included.

The natural fertility is medium, and the content of organic matter is low. The reaction is medium to strongly acid. Internal drainage is somewhat impaired to slow, and percolation of moisture is greatly retarded by the firm subsoil. Roots, however, can penetrate the soil material to shale bedrock.

Use and management.—All of this soil has been cleared and used for crops at some time but a small part is now idle. Corn, small grains, and lespedeza hay are the chief crops. Small acreages of alfalfa, tobacco, soybeans, and vegetables are grown. Rather short rotations are in common use, and some fertilization is practiced for most crops. Organic matter is not usually added either through application of manure or the turning under of winter legume crops. Alfalfa and tobacco ordinarily are rather heavily fertilized; a great part of the acreage receives 2 to 3 tons of lime an acre every 6 to 10 years. Under ordinary conditions corn yields about 20 bushels, wheat 10 bushels, and lespedeza 0.7 ton an acre. Pasture is not of high quality and ordinarily produces 40 cow-acre-days of grazing.

This soil is considered suitable for both tilled crops and pasture, but its management requirements are somewhat exacting. Fertility should be kept at a high level, and moderately long rotations consisting chiefly of fall-sown small grains and grasses and legumes for hay and pasture are a necessary part of good management. The rather strong slope and the slow permeability of the subsoil cause runoff to be hazardous where the soil is not well protected by vegetation. Strip cropping and subsoiling may be practical means of restraining erosion.

Areas not required for crops can be brought to a fairly high state of fertility for pasture. Where high fertility and good tilth are established and maintained and erosion is adequately checked, corn will yield 35 bushels and alfalfa about 2.5 tons an acre. Under such conditions the more desirable pasture grasses and legumes maintain a good cover and produce about 85 cow-acre-days of grazing.

Sequoia silty clay loam, severely eroded rolling phase (5–12% slopes) (SM).—This phase consists of areas of Sequoia silt loam that have a rolling surface and are so eroded that practically all of the surface soil has been lost. Shallow gullies are common, and some gullies are too large to be obliterated by tillage. The separate areas of this fairly extensive soil are 5 to 40 acres in size and are widely scattered throughout the Sequoia-Leadvale, Sequoia-Litz-Dandridge, and Dandridge-Litz-Leadvale soil associations. Although the predominant slope range is 5 to 12 percent, small tracts on ridge crests have a smoother surface.

The plow layer consists chiefly of reddish-yellow very firm silty clay loam or silty clay. Shale bedrock is at depths of ½ to 1½ feet, but there are places on the more exposed slopes where shale practically outcrops and a few where thin limestone beds outcrop. In some areas the subsoil is more nearly brownish yellow, quite plastic, and similar to that of Colbert silty clay. Because of their small size and close association with Sequoia soils, these Colbert areas were included with this Sequoia soil in mapping.

The natural fertility and content of organic matter are very low for Sequoia silty clay loam, severely eroded rolling phase. The clayey plow layer makes permeability to moisture very slow and causes the soil to puddle easily when wet and to become hard quickly as it dries. The reaction is medium to strongly acid.

Use and management.—All of the acreage has been cleared and cropped at some time. A great part is now idle or used as unimproved pasture. The growth on these areas consists chiefly of sassafras, briers, and broomsedge, with some lespedeza and other grasses intermixed. Small acreages have been improved for pasture or are used for crops, chiefly small grains, hay, and corn. Management on much of the acreage is not at a high level. Erosion is active and yields are usually low.

The rolling surface, low fertility, and slow permeability make this soil rather poorly suited to tilled crops, but it is fairly well suited to pasture if fertility is built to a high level and desirable pasture plants are established. The carrying capacity, however, even under the most favorable conditions, is limited by its droughtiness. Those areas needed for crops generally require organic matter, lime, and plant nutrients. If the soil is to be maintained under cropping, exceptionally long rotations consisting chiefly of fall-sown small grains and grasses and legumes are necessary. Under the most favorable conditions corn should yield about 20 bushels and lespedeza 0.8 ton an acre. The carrying capacity of pasture will be about 50 cow-acre-days under favorable management, but most of the grazing will be confined to the moister parts of the growing season.

Sequoia-Bland silty clay loams, eroded undulating phases (2–5% slopes) (SD).—In this complex are areas of Sequoia and Bland soils so small and thoroughly intermingled that they could not be de-

lineated separately on the soil map. Practically all of this complex is in the Sequoia-Bland and the Sequoia-Leadvale soil associations. The areas are irregular. They occupy the higher parts of the landscape, which consists of rather smooth low-lying ridges.

The Sequoia soil is approximately as described for Sequoia silty clay loam, eroded undulating phase. It has a grayish-yellow silt loam or silty clay loam plow layer and a reddish-yellow very firm silty clay subsoil over calcareous shale or interbedded shale and limestone.

Those parts consisting of Bland soil have dusky-red or weak-red rather clayey soil over dusky-red or weak-red shaly limestone. The surface 3 to 5 inches is weak-red or dusky-red silt loam, and the subsoil is dusky-red very firm silty clay or clay. Shaly limestone bedrock is at depths of 1 to 3½ feet.

On the smoother parts of some of the ridge crests, the Bland areas are 2 to 3½ feet deep over bedrock and have a subsoil with a fairly well defined nut structure. That is, the material breaks easily from place as fragments ½ to 1½ inches in diameter. In these places the Bland soil greatly predominates over the Sequoia.

The amount of erosion varies greatly from place to place in this complex. For much of the acreage, the surface soil is mixed with the subsoil in the plow layer. A small acreage, however, has not been so eroded and has an unmixed surface soil consisting predominantly of silt loam. In numerous other spots practically all the surface layer has been lost and the plow layer is silty clay loam or silty clay.

The natural fertility is moderate to rather low, and the content of organic matter is rather low. The soil is slightly acid to slightly alkaline where shaly limestone bedrock is at or near the surface but is medium acid where bedrock is less exposed. Internal drainage is notably impaired. Infiltration of moisture is slow except on the smoother parts where the depth to bedrock is 3 feet or more. The tilth varies from place to place; it is favorable only on the smoother less eroded parts, where the texture is predominantly silt loam.

Use and management.—A great part of the acreage has been cleared and cropped and much of it is used for small grains, corn, and pasture. In the more desirable areas some alfalfa, tobacco, and vegetables are grown. Yields vary greatly according to the depth to bedrock, results of erosion, and the level of management practiced. Under ordinary conditions corn yields about 20 bushels and lespedeza 0.8 ton. Chiefly because of the rather dry nature and rather low level of fertility, the carrying capacity of pasture is about 45 cow-acre-days.

The smooth surface makes this soil favorable for crops and pasture, but the variable depth to the slowly permeable clay subsoil necessitates careful management, especially on the more sloping parts. The soil is not well suited to crops requiring a plow layer with good tilth. It is best used for small grains, grasses and legumes for pasture and hay, and occasionally row crops. Row crops should be grown at intervals of less than 4 or 5 years. Limited moisture is available to crops where the soil is shallow to the clayey material. Some smoother parts, however, have 5 to 8 inches of silt material and bedrock at depths of more than 2 feet. These deeper areas will produce relatively good yields of most commonly grown crops if their fertility has been improved and is maintained. Generally the more desirable grasses and legumes are not difficult to maintain where the soil has been ade-

quately fertilized. Under a high level of management, most areas will produce 38 bushels of corn, 20 bushels of wheat, and 1.4 tons of lespedeza an acre. Pasture, under favorable conditions, has a carrying capacity of about 95 cow-acre-days.

Sequoia-Bland silty clay loams, eroded rolling phases (5–12% slopes) (Sc).—Rolling areas of Sequoia-Bland silty clay loams are in this complex. It is one of the more extensive of Sequoia-Bland complexes. There are many areas widely distributed throughout the Sequoia-Bland and the Sequoia-Leadvale soil associations. A great part has been so eroded that the plow layer now consists of a mixture of original surface soil and subsoil material. The depth to bedrock is generally less than for the eroded undulating phases of Sequoia-Bland silty clay loams, and shaly outcrops are not uncommon.

Use and management.—Nearly all the land has been cleared and cropped at some time and much is now used for small grains, hay, and pasture. There is a small acreage of corn and alfalfa. Crops such as tobacco and vegetables are not common. Rotations of moderate length prevail, and a little fertilization is practiced. A great many areas are actively eroding. Under ordinary conditions corn yields about 18 bushels and lespedeza about 0.6 ton an acre. There is little desirable grazing, as the dryness of the soils limits the period of productivity. Consequently, the carrying capacity of pasture is rather low.

These soils are considered suitable for cultivated crops, but the rolling surface, clayey nature, and rather shallow depth to bedrock necessitate exacting management. Close-growing small grains and grasses and legumes for hay and pasture must occupy these soils most of the time if they are to be protected against erosion. The dryness limits productivity, but adequate applications of fertilizer, lime, and organic matter will greatly improve most of the acreage. The more desirable grasses and legumes can be grown where the fertility is kept high. Under this management oats will yield 35 bushels, alfalfa 2.3 tons, and lespedeza about 1.3 tons an acre, and the carrying capacity of pasture can be increased to about 80 cow-acre-days. Good grazing is restricted to the moister parts of the growing season.

Sequoia-Bland silty clay loams, severely eroded rolling phases (5–12% slopes) (Sf).—This complex is made up of rolling areas of Sequoia-Bland silty clay loams that have been so eroded that the plow layer now consists almost entirely of what was originally subsoil material. It is less extensive than the complexes of eroded undulating and eroded rolling phases. The separate areas range chiefly from 3 to 10 acres in size and are fairly numerous and widely distributed throughout the Sequoia-Bland and the Sequoia-Leadvale soil associations.

The plow layer is reddish-yellow (Sequoia) or dusky-red (Bland) very firm silty clay loam. Shale bedrock or dusky-red shaly limestone is at depths of ½ to 1½ feet, and shaly limestone outcrops are not uncommon.

The natural fertility is low and the content of organic matter very low. The reaction ranges from slightly alkaline near some of the bedrock outcrops to medium or strongly acid elsewhere. Slow permeability and unfavorable tilth make the soil droughty and difficult to work.

Use and management.—All of the acreage has been cleared and cropped at some time, but only a small part is cultivated now. Much is idle and occupied by a variable growth of sassafras, briers, and broomsedge. Some areas are used as unimproved pasture, which is of low carrying capacity and poor quality because the soils are droughty.

These soils are considered very poorly suitable for crops, chiefly because of droughtiness, poor tilth, low fertility, and great susceptibility to erosion. They are capable of supplying some pasture if their fertility is brought to a fairly high level and the more desirable grasses and legumes are established. The carrying capacity is limited by the droughtiness; even under the most favorable conditions it is only about 45 cow-acre-days of grazing.

Sequoia-Bland silty clay loams, eroded hilly phases (12–25% slopes) (Sb).—This complex consists of eroded and hilly areas of Sequoia-Bland silty clay loams. Most of it lies on narrow, rather steep slopes below and adjacent to broader areas of smoother complexes of Sequoia-Bland soils. The separate areas range from approximately 5 to 20 acres in size. This complex is not so common as other complexes of Sequoia-Bland soils but is widely distributed throughout the Sequoia-Bland soil association.

Although a small part is not materially eroded and has a surface layer of grayish-yellow or weak-red silt loam to a depth of 4 to 6 inches, most of the complex is so eroded that the plow layer is predominantly silty clay loam. The subsoil, a reddish-yellow or dusky-red firm silty clay, is generally shallow to bedrock, or ½ to 2 feet deep in most places.

The less eroded areas are moderate in fertility and have a moderate content of organic matter. A great part of the acreage, however, is rather low in fertility and organic matter because of losses resulting from erosion and cropping.

Use and management.—Only a small part of this complex has not been cleared. Most of the cleared land has been used for tilled crops, though only a small part is now cultivated. Some is idle but a notable acreage is used as unimproved pasture. On the less eroded areas where the forest cover has been removed, the grazing is fair; it consists at least in part of bluegrass and white clover. Less desirable vegetation grows on the more eroded areas.

These soils are poorly suited to crops because of their strong slope, slow permeability, and shallowness to bedrock. They can supply a fair amount of grazing if fertility is brought to a fairly high level and desirable vegetation is established. Under such favorable conditions, a carrying capacity of approximately 70 cow-acre-days may be maintained. If they are to be protected against further erosion, areas that must be used for crops will require rotations consisting entirely of close-growing small grains and grasses and legumes for hay and pasture. Where the fertility is kept high and other good management is practiced, wheat will yield about 16 bushels and alfalfa 2 tons an acre.

Sequoia-Bland silty clay loams, severely eroded hilly phases (12–25% slopes) (Se.)—This complex consists of hilly areas of Sequoia-Bland silty clay loams from which erosion has removed practically all of the surface layer and, in places, part of the subsoil.

There are a few gullies, some too large to be obliterated by tillage and a few that cannot be crossed with farm machinery. The few small tracts occur as narrow strips on strong slopes below smoother complexes of Sequoia-Bland soils. Areas of this complex are widely distributed throughout the Sequoia-Bland soil association.

The plow layer ranges from reddish-yellow (Sequoia) to dusky-red (Bland); it is a very firm silty clay loam or silty clay. Shale bedrock or shaly limestone is at depths of ½ to 1½ feet. Shaly limestone outcrops are common, though not numerous enough to prohibit tillage.

The natural fertility is low, and the content of organic matter very low. The soils are slightly alkaline to medium or strongly acid. They are very slowly permeable to moisture, have very unfavorable tilth, and are difficult to work because they become hard quickly on drying and puddle easily when wet.

Use and management.—All of the acreage has been cleared and cropped at some time, but practically all of it is now used as unimproved pasture or lies idle. Much of the acreage supports a rather sparse growth that consists chiefly of broomsedge, with sassafras and briers in places. Some of the acreage, however, has a fair stand of the more desirable grasses and legumes and less brush and weeds. Little fertilizer is applied, but probably a small acreage has been limed. Under ordinary conditions the carrying capacity of pasture is about 20 cow-acre-days.

These soils are not suited to crops requiring tillage. Poor tilth, slow permeability, shallowness to bedrock, and strong slope make proper management extremely exacting and high yields impractical. They are capable of producing some pasture; but if a good cover of the more desirable legumes and grasses is to be maintained, adequate fertilization and proper seeding are necessary. Periods of good grazing are rather limited, since vegetation suffers early during dry periods because of the low moisture-holding capacity. Under good management pasture will have a carrying capacity of about 40 cow-acre-days.

Staser silt loam (0–2% slopes) (Sr).—This is a well-drained soil on bottom lands along the creeks and consists of alluvium washed largely from shales. The areas are associated with Hamblen and Prader soils and range in size from about 8 to 80 acres. They lie on the higher parts of the bottom lands, and though subject to flooding, are somewhat less so than the Hamblen and Prader soils.

Profile description:

0 to 12 inches, grayish-brown or light yellowish-brown silt loam.
12 to 24 inches, light-brown or light yellowish-brown friable silt loam or silty clay loam.
24 to 40 inches, light-brown silty clay loam; some gray and brown mottles and dark concretions; shale bedrock at depths of 5 to 30 feet.

The natural fertility of this soil is moderately high and the content of organic matter moderate. The reaction ranges from medium acid to alkaline. The soil is permeable to roots and moisture. The depth to the water table varies notably. During the drier seasons, it may be at 7 or 8 feet; whereas during periods of high precipitation, the areas may be inundated. During a great part of the growing season, however, water is at depths of 3 to 5 feet. The tilth is favorable, but flooding is a hazard to practically all crops and pasture.

Use and management.—A great part of this soil is cleared. Much is used for corn; the smaller part is used for lespedeza-and-grass hay and pasture. Fertilization is not common but in places 100 to 200 pounds of 20-percent phosphate or 0–10–4 or 2–12–2 fertilizer is used for the corn. Little manure is applied. Under ordinary conditions corn yields about 45 bushels and lespedeza 1.4 tons an acre.

This productive soil is easily worked and conserved. Its natural fertility is a little lower than that of Huntington silt loam. It is suited to a wide range of crops and can be used intensively for row crops, since fertility is easily maintained and erosion does not occur. It is more widely adapted to crops than the Hamblen soil, chiefly because of better drainage and less susceptibility to flooding.

The lime requirement ranges from approximately 2 tons an acre every 5 to 6 years on the more acid parts to none on the more alkaline areas. Although natural fertility is relatively high, crops respond to fertilization. Where a high level of management is practiced, corn will yield 65 bushels, wheat 20 bushels, and lespedeza 2 tons an acre. Like the Hamblen soils, Staser silt loam is desirable for pasture, especially for midsummer grazing. Nevertheless, it is a little more sensitive to periods of low rainfall. Where good pasture plants have been established, weeds are controlled, and the fertility has been brought to a high level, the carrying capacity is approximately 145 cow-acre-days.

Staser fine sandy loam (0–3% slopes) (So).—This is a well-drained sandy soil on the bottom lands along the Holston, Clinch, and Tennessee Rivers. It consists of mixed general alluvium. The areas are associated with Huntington and Lindside soils and occupy the natural levees on the highest parts of the bottom lands relatively close to the river channels.

Profile description:

0 to 12 inches, light-brown to grayish-brown fine sandy loam.
12 to 36 inches, light-brown or brownish-yellow fine sandy loam that generally is firmer than the surface layer but still friable; material below this layer may be mottled with gray and brown; shale or limestone bedrock at depths of many feet, probably between 25 and 35.

In places the subsoil is more sandy, or it may be silt loam or clay loam. There are some areas where the entire profile is predominantly loamy fine sand.

The natural fertility of this soil is moderate, and the organic matter content is not high. The reaction is slightly acid to medium acid. Internal drainage is moderately rapid. The soil is notably permeable to both roots and moisture, and infiltration of water is rapid. Under natural conditions the soil was subject to periodic flooding, but since the construction of flood-control dams upstream on the Holston and Clinch Rivers, this hazard has diminished.

Use and management.—Almost all of this soil is used for corn, hay, and small grains. Only a small part is pastured. The chief hay crops are mixed lespedeza and redtop and mixed timothy and red clover. Johnson grass is common in many places, and Bermuda grass is an important part of the grazing vegetation. Fertilization is light and confined chiefly to small grains and vegetables. Short rotations prevail. Row crops, chiefly corn, are grown on many areas several years in succession.

This soil is well suited to intensive row-crop production, as it is not subject to erosion, is easily worked, and responds well to fertilization. It is suited to a wide variety of crops, including truck crops, tobacco, and alfalfa. Moderately heavy fertilization is required if good yields are to be obtained. Because of the sandiness of this soil, fertilizers should be applied at frequent intervals. Under good management corn will yield 58 bushels, oats 45 bushels, tobacco 1,700 pounds an acre, and pasture 115 cow-acre-days of grazing.

Staser fine sandy loam, low-bottom phase (0–3% slopes) (Sp).—This well-drained sandy soil occurs on low bottom lands along the Holston, Clinch, and Tennessee Rivers. It differs from Staser fine sandy loam in occupying lower lying strips adjacent to the river channels and is usually only a few feet above the surface of the river. It is therefore more subject to overflow.

The surface layer is a little darker brown than that of Staser fine sandy loam. In most places the surface 12 inches is grayish-brown or brown fine sandy loam underlain by a lighter-brown or brownish-yellow fine sandy loam that grades with depth to more sandy material. Depth to bedrock varies, but in most places is from 8 to 25 feet. Some areas have a texture that is more nearly loamy fine sand and a lighter brown surface layer.

The natural fertility is moderate, and the organic-matter content is not high. The reaction is slightly acid to medium acid. Internal drainage is moderate to excessive. This soil is notably permeable to both roots and moisture, and infiltration of water is rapid. Although this soil occupies a position that would normally cause it to be flooded by relatively low flood stages, this hazard has been diminished by flood-control dams upstream on the Holston and Clinch Rivers.

Use and management.—Almost all of the acreage is used for corn and hay crops. A little is used for pasture, and practically none is under forest. The chief hay crops are mixed lespedeza and redtop and mixed timothy and red clover. Johnson grass is common. Fertilization under average conditions is light to moderate and confined chiefly to corn. Short rotations prevail, and row crops, chiefly corn, are grown on many areas several years in succession.

This soil is well suited to intensive row-crop production, as it is not subject to erosion, is easily worked, and responds well to fertilization. A wide variety of crops can be grown, including truck crops, tobacco, and alfalfa. Crops will respond to heavy applications of fertilizer, which because of the sandiness of the soil, should be made at frequent intervals. Where fertilization is adequate and other management is at a high level, corn can be expected to yield about 60 bushels and lespedeza 1.9 tons an acre.

Stony rolling land, Colbert and Talbott soil materials (7–15% slopes) (St).—This miscellaneous land type is characterized by numerous outcrops of limestone and loose rock that occupy 10 to 50 percent of the surface and make tillage impractical. In most places the limestone is the kind that gives rise to Colbert and Talbott soils, but in a few it is like that from which Dewey soils have developed. The soil material resembles that of the Colbert or Talbott soils. This stony land type differs from those soils chiefly in its shallower depth to bedrock and relative abundance of limestone outcrops and rock

fragments. The many separate areas range from 5 to 30 acres or more in size and are practically all in the Stony land-Talbott soil association.

Use and management.—More than half of this land type has been cleared but it is cultivated only in a few patches, usually by hand. Cut-over forest, chiefly cedars and oaks, is on the acreage not cleared. A great part is used for pasture, much of which has a fair stand of bluegrass and white clover. The average carrying capacity is about 25 cow-acre-days.

Because of the great abundance of limestone outcrops and rock fragments, this land type is not suited to tilled crops. The eroded parts are rather low in plant nutrients and organic matter. In contrast, cleared areas that have not been greatly eroded as a result of extreme overgrazing or attempts at cultivation are moderately fertile. Chiefly because of the clayey soil material and the shallow depth to bedrock, a great part of the acreage is droughty. Grazing is restricted to moister periods during the grazing season. Pasture can be expected to respond to lime, and to fertilizer, especially phosphorus. Where adequate fertilization and proper vegetation are maintained, a carrying capacity of approximately 60 cow-acre-days can be achieved.

Stony hilly and steep land, Colbert and Talbott soil materials (15–45% slopes) (Ss).—This land type differs from Stony rolling land, Colbert and Talbott soil materials, chiefly in having a stronger slope. Rock outcrops generally occupy a great part of the surface. The depth to bedrock averages less than for the rolling land type. In a few places depth to bedrock exceeds 1½ or 2 feet but in most places it is less than 12 inches.

Use and management.—Chiefly because of the abundance of rock outcrops and loose fragments, this land is not suited to crops requiring tillage. It does have enough soil material to be useful as pasture. Probably half the acreage has been cleared but little or none has been cultivated. A cut-over mixed stand of cedar and deciduous hardwoods occupies most of the uncleared area. Clayiness and shallow depth to bedrock make the soil droughty. Grazing is therefore restricted to the moister periods of the pasture season. Bluegrass and white clover establish easily; they respond to fertilization, especially with phosphorus, and in many places to applications of lime. Where adequate fertilization is practiced and grazing is carefully managed, a carrying capacity of approximately 45 cow-acre-days can be maintained in most places.

Stony very steep land, Muskingum soil material (60+% slopes) (Su).—This land type occupies areas that are unsuitable for either crops or pasture because of their abundant sandstone outcrops and loose rock. Practically all of it is on the steep slopes of House Mountain. Muskingum soil material, which is predominantly light-brown fine sandy loam grading to brownish-yellow fine sandy clay loam, occupies the interstices or limited areas between the rocks. This soil material, except in a few places, is more than 1 or 1½ feet thick.

A mixture of oaks and shortleaf and Virginia pine grows on most of this land type. Little land has been cleared. Because of the great abundance of rocks, the suitability of this land type is limited to

forest. It is not very productive, however, and because of its very strong slope and stoniness, access for care and harvesting of the trees is difficult.

Talbott silty clay loam, eroded undulating phase (2–5% slopes) (Tb).—Like other soils of the Talbott series, this phase has a compact subsoil and a moderately shallow depth to clayey (argillaceous) limestone parent rock. Also, it somewhat resembles the Dewey and Decatur soils in the color of the surface layer and subsoil but is tighter or firmer and less deep to bedrock. A great part of it is in areas of the Stony land-Talbott soil association, but a small part is associated with the Dewey and Decatur soils in areas of the Decatur-Dewey-Emory soil association. The surface is smooth.

Profile description:

0 to 5 inches, grayish-brown silt loam or silty clay loam.
5 to 18 inches, red plastic clay.
18 inches+, very firm or tight slightly lighter red clay; bedrock at depths of 3 to 6 feet.

The thickness of the surface layer depends chiefly on the degree of erosion and ranges from 3 to 8 inches. The texture is more nearly silt loam than silty clay loam where this layer is thicker. The color of the subsoil ranges from reddish yellow to red, and in places the lower subsoil, that is, the material below a depth of about 20 inches, is mottled reddish yellow and yellow, with a small amount of gray. There are few rock outcrops.

This is a moderately fertile soil, although the content of organic matter is not high. The reaction is medium to strongly acid. Internal drainage is impaired by the slow permeability of the subsoil. Roots penetrate the material, but with less ease than in some of the more friable soils. The capacity for holding moisture available to plants is fair, but the soil generally has somewhat less favorable moisture relations than the comparable Dewey and Emory soils. Tilth of the plow layer is rather heavy except where the surface layer is over 5 inches thick and predominantly silt loam.

Use and management.—Practically all of this soil has been cleared and cropped. At the present time it is used for corn, small grains, hay, and pasture. Some tobacco and vegetables are also grown. Lespedeza, redtop, timothy, and orchard grass are the chief crops used for hay. Moderately short rotations prevail, and lime has been applied to much of the acreage. Little manure is used and winter cover crops to be turned under are unusual. Under ordinary conditions corn and small grains are fertilized with 75 to 125 pounds an acre of 20-percent phosphate or a mixed fertilizer. Vegetables and tobacco are treated with 500 to 1,000 pounds an acre of high grade fertilizer. Tillage generally is shallow, and contour tillage is not commonly practiced. Under these conditions corn yields about 25 bushels, wheat 14 bushels, and alfalfa 2.6 tons an acre.

This soil is well suited to many of the crops commonly grown, including corn, small grains, alfalfa, and tobacco. It is less favorable for root crops and many other truck crops than the more permeable fertile soils. Its suitability is limited by compactness of the subsoil and rather shallow depth. Alfalfa is well suited. If fertility and lime requirements are met, the more desirable legumes and grasses for

hay or pasture produce well. Droughtiness caused by the heavy clayey subsoil limits the growth of pasture during drier periods of the grazing season. Most areas of this soil are suited to 3- or 4-year rotations, but some care is required to control runoff adequately on the more sloping parts, as it accumulates rather rapidly during heavy rains.

Where the fertility is kept high, organic matter is supplied, and adequate lime is applied, alfalfa will yield about 3.1 tons, oats 47 bushels, and corn 48 bushels. Although the more permeable fertile soils produce more tobacco, yields of approximately 1,400 pounds can be expected on this soil if it is kept in good condition. Under good management the carrying capacity of mixed legume-and-grass pasture of high quality can be kept at about 110 cow-acre-days.

Talbott silty clay loam, eroded rolling phase (5–12% slopes) (TA).—This soil differs from the eroded undulating phase chiefly in having a more sloping surface. It is one of the more extensive of the Talbott soils. The many areas range from at few acres to 20 or 30 acres in size and occur throughout the Stony land-Talbott soil association. A few are associated with Decatur and Dewey soils.

Since most of this phase is somewhat more eroded than the eroded undulating phase, the surface layer on the whole is shallower and more nearly a silty clay loam. The subsoil is predominantly red plastic clay that becomes tighter and more compact with depth. Clayey or argillaceous limestone bedrock is at depths of 2 to 6 feet. A few areas have a moderate amount of fine chert throughout the surface soil and subsoil, but not enough to interfere greatly with plant growth or cultivation.

The natural fertility of this eroded soil is moderate, and the content of organic matter rather low. The reaction is medium to strongly acid. The heavy or compact subsoil causes slow infiltration of moisture and somewhat impaired internal drainage. As for the eroded undulating phase, the soil material is too firm to be well suited to root crops such as potatoes. The capacity of the soil to hold moisture available to plants is fair, yet notably less favorable than that of many of the more permeable soils.

Use and management.—Almost all of this soil has been cleared and cropped and at the present time is used chiefly for small grains, pasture, and some row crops such as corn and tobacco. Lespedeza, redtop, timothy, or orchard grass are among the more common hay crops, but some alfalfa and red clover are grown. Fertilization is practiced to some extent, and lime has been applied to much of the acreage. Rotations last from 2 to 4 years. Winter cover crops are not commonly grown, although there is a small acreage on some farms. Under ordinary conditions corn yields about 25 bushels and lespedeza 0.9 ton an acre.

This soil is suited to many of the crops commonly grown; but chiefly because of its slow permeability and rather strong slope, it is not well suited to row crops. Of the common crops, small grains, alfalfa, red clover, orchard grass, and certain other grasses are among the better suited. Truck crops are not particularly well suited, because of the unfavorable tilth and the difficulty in controlling erosion where the soil is kept in cultivation. Because of droughtiness, the soil pro-

duces good pasture only during the moister periods of the growing season.

This soil requires lime, organic matter, and most of the plant nutrients, especially phosphorus, if it is to be kept productive. A dense plant cover should be kept on it a great part of the time to improve the soil and reduce erosion. Moderately long rotations are required in which winter cover crops consistently follow row crops. Doing field work on the contour and strip cropping will aid in restraining erosion caused by runoff. Where the fertility and organic-matter content are kept at a high level, favorable tilth is established, and runoff is adequately controlled, alfalfa will yield about 2.8 tons, oats 42 bushels, and wheat 23 bushels an acre. Under these conditions high quality pastures with a carrying capacity of about 105 cow-acre-days can be maintained.

Talbott silty clay loam, severely eroded rolling phase (5–12% slopes) (TD).—This phase comprises rolling areas of Talbott soil from which erosion has removed practically all of the original surface soil and, in places, part of the subsoil. Much of it occurs in moderately small areas throughout the Stony land-Talbott soil association.

The plow layer consists of red very firm silty clay loam or silty clay. Limestone bedrock is at depths of 1½ to 5 feet. A few areas have a moderate quality of small chert distributed throughout the surface soil and subsoil, but not enough to interfere greatly with cultivation or plant growth. Rock outcrops are more common than on the eroded undulating phase, but are not numerous enough to prohibit tillage.

The natural fertility and organic-matter content are low, and the tilth is extremely unfavorable. The capacity of the soil to hold moisture for plants is small. The plow layer puddles easily when wet and becomes hard within a short time after drying. Because of the slow rate of infiltration, runoff develops quickly during rains.

Use and management.—All of this soil has been cleared and cropped at some time. Much of it is now idle or in unimproved pasture. Pastures generally are not of high quality and have a low carrying capacity. The stand is chiefly lespedeza and broomsedge, with some other grasses and brushy growth. Lime has been applied to some of the acreage and a variable amount of fertilizer used, most of it on the cropped acreage. Crop yields are low.

The low capacity for holding moisture available to crops, the rapid rate of runoff, the generally low level of fertility, and the unfavorable tilth make this soil poorly suited to crops. It is suited to permanent pasture; but to be productive, its fertility and supply of organic matter and lime will have to be increased. In addition, measures are needed to restrain runoff until a good permanent plant cover has been established. Under such management the more desirable legumes and grasses can be grown and a carrying capacity of 60 cow-acre-days can be expected. Even under favorable management, droughtiness restricts the growth of pasture plants to moister periods during the growing season.

Talbott silty clay loam, severely eroded hilly phase (12–25% slopes) (TC).—This soil comprises all the hilly areas of Talbott soils. The quantity of material lost through erosion varies greatly. Although a few areas still have the original grayish-brown silt loam

surface layer, a great part of the acreage has lost practically all of the original surface soil and in places part of the subsoil. The plow layer generally consists of red very firm silty clay loam or silty clay, and limestone bedrock is at depths of 1 to 4 feet. Bedrock outcrops are common but not numerous enough to prohibit tillage.

The natural fertility of much of this soil is low, and the organic-matter content is very low. The reaction is medium to strongly acid. The soil is slowly permeable and the tilth of the tight clayey plow layer is unfavorable. The slow permeability causes runoff to develop rapidly during rains, and as a result small gullies are common. Some gullies are too large to be obliterated by cultivation.

Use and management.—A great part of this soil has been cleared and cropped at some time. Only a small acreage is still under forest, which consists of cut-over deciduous hardwoods, chiefly oaks. Much is used for pasture and some is idle. The chief crops grown on the small cultivated acreage are corn, small grains, and lespedeza. Their management is not at a high level and fertilization is not heavy. Most pastures have been treated with some lime, but the vegetation is not of high quality.

The strong slope, unfavorable tilth, low fertility, and slow infiltration of moisture make this soil poorly suited to crops. Where the fertility, organic matter, and lime requirements are met, the more desirable legumes and grasses produce fair pasture. Under favorable conditions they provide about 50 cow-acre-days of grazing. Because of unfavorable moisture relations, this soil produces good pasture only during the moister parts of the growing season.

Tellico loam, hilly phase (12–25% slopes) (Tm).—This is a reddish friable soil developed from calcareous sandstone. It occurs in the hilly to steep landscape of the Tellico-Neubert soil association.

Profile description:

0 to 6 inches, light reddish-brown fine sandy loam or loam.
6 to 24 inches, dark-red or dark reddish-brown friable to firm sandy clay.
24 to 40 inches, red or dark-red, grading to lighter red, sandy clay or sandy clay loam; calcareous sandstone bedrock (pl. 12, *A*) at depths of 3 to 12 feet

In some places the deep subsoil is silty clay; in others the material below a depth of about 30 inches is thoroughly weathered sandy shale that is finely laminated brown, weak red, and yellow.

The natural fertility and organic-matter content are moderate, and the reaction is medium to strongly acid. Internal drainage is medium. The infiltration of moisture is rapid. The soil is easily permeable to roots as well as to moisture, and its capacity for holding moisture available to plants is moderately high.

Use and management.—In general this soil occupies those hilly areas of Tellico soil under native forest, which consists chiefly of mixed hardwoods and pines. It is suitable for crops requiring tillage; but chiefly because of strong slope, it is not well suited to short rotations. Although the rate of infiltration is relatively high, the friable soil material erodes easily. Because it is permeable and friable, the soil is favorable for the growth of truck crops. This use should be restricted, however, because of the erosion hazard. The soil is suited to a wide variety of other crops and responds well to proper fertilization. A good pasture sod that will protect the soil effectively against

erosion slips is difficult to maintain. Lime, organic matter, and phosphorus are among the chief fertilizer requirements. Where high fertility is developed and runoff is properly restrained, corn will yield about 35 bushels, oats 36 bushels, and alfalfa 2.5 tons an acre. Many truck crops produce well if good management is practiced; they are of good quality and available for market at an earlier date than on many of the other soils of the county.

Tellico loam, eroded hilly phase (12–25% slopes) (TH).—This phase comprises those areas, formerly of Tellico loam, hilly phase, that have lost an appreciable part of the surface soil through erosion. The plow layer in most places consists of a mixture of original surface soil and some subsoil material and is predominantly light reddish-brown or reddish-brown loam. Calcareous sandstone is at depths of 3 to 12 feet. This is one of the more extensive Tellico soils. The separate areas range from 5 to 40 acres or more in size and are widely distributed throughout the Tellico-Neubert soil association.

The soil is a little lower in natural fertility than the hilly phase but is moderately fertile and capable of responding to good management. Its reaction is medium to strongly acid. It is permeable to roots and moisture, and the capacity for holding moisture available to plants is fairly high.

Use and management.—All of this soil (pl. 12, *B*) has been cleared and cropped at some time. About 15 percent is now used for crops and a small part is idle, but the greater part is used for pasture and hay. Corn and vegetables are the chief cultivated crops, and lespedeza and redtop the chief hay crops, although some alfalfa is grown. Corn is not commonly fertilized but vegetables and alfalfa receive relatively heavy applications of high grade fertilizer and some manure. Much of the acreage has received some lime. Crop rotations are rather short in the cultivated parts and erosion is active. Under ordinary conditions corn yields about 18 bushels, wheat 8 bushels, and lespedeza 0.7 ton an acre.

This soil is considered suitable for crops but requires rather exacting management because of its strong slope and moderate fertility. It is not well suited to frequent use for row crops, and care is generally required to restrain erosion. Use of long rotations and addition of fertilizer, lime, and organic matter in adequate amounts are necessary if high fertility is to be maintained. The soil is friable and permeable and therefore particularly well suited to vegetables, which mature early and are of good quality. Nevertheless, small grains and pasture crops should dominate in the rotations. Field work should be done on the contour wherever possible, and strip cropping may be feasible for runoff control. Under favorable conditions alfalfa will yield 2.3 tons, oats 33 bushels, and lespedeza about 1.4 tons an acre. Pasture, properly limed, fertilized, and seeded, has a carrying capacity of approximately 80 cow-acre-days.

Tellico clay loam, severely eroded hilly phase (12–25% slopes) (TE).—In this phase are areas formerly occupied by Tellico loam from which erosion has removed practically all of the original surface soil and, in places, part of the subsoil. There are gullies, some of which are too large to be obliterated by tillage. The separate tracts of this soil range from less than 5 acres to more than 60 acres in size

and are widely distributed throughout the Tellico-Neubert soil association.

The plow layer is a dark-red friable clay loam or sandy clay, or much like the underlying subsoil. Calcareous sandstone bedrock or shaly material is at depths of 2 to 10 feet.

The natural fertility and content of organic matter are low, and the reaction is medium to strongly acid. Tilth is less favorable than it would be if erosion had not occurred but is much better for this soil than for severely eroded Dewey, Decatur, and most other soils consisting of limestone residuum. Percolation of moisture is retarded but roots appear to penetrate the soil material without great difficulty. The capacity for holding moisture available to plants is limited, and the soil is therefore rather droughty.

Use and management.—All of this soil has been cleared and cultivated at some time. Much of it is now idle. Some parts have a volunteer stand of Virginia and shortleaf pine or a variable cover of briers, broomsedge, sassafras, and other brushy growth. The areas used as unimproved pasture have a sparse cover of broomsedge and lespedeza. A few pastures have received good care and produce a good stand of grasses, chiefly Bermuda grass and bluegrass. The small cropped acreage is used mainly for corn, vegetables, and hay. Erosion is active on most of this acreage and fertilization is light except for vegetables. Yields generally are low, lespedeza producing about 0.3 ton an acre.

Unfavorable tilth and moisture relations, strong slope, and low fertility make this soil poorly suited to crops. Where properly fertilized, limed, and seeded, fairly good pasture consisting of more desirable plants such as orchard grass, bluegrass, Bermuda grass, and white clover can be maintained. Erosion is a hazard even under grass, as the soil material is easily moved by runoff water. The droughtiness limits good grazing to the moister parts of the growing season, and under proper management the carrying capacity probably will not exceed 45 to 60 cow-acre-days. Areas that must be used for crops require long rotations consisting chiefly of fall-sown small grains and hay crops. Ample fertilization, including addition of lime and organic matter, is needed to obtain fairly high yields and to maintain favorable tilth and moisture conditions.

Tellico loam, steep phase (25+% slopes) (To).—This steep phase differs from the hilly phase chiefly in having stronger slopes that range up to 50 percent. In addition, the depth to bedrock is more variable and generally shallower. In most places bedrock is 2 to 9 feet from the surface. Rock outcrops are fairly common. The areas are somewhat large, some of them 200 to 300 acres in size.

The surface soil, varying from 3 to 5 inches in thickness, is light reddish-brown friable loam or fine sandy loam. The subsoil is dark-red or dark reddish-brown friable but firm sandy clay loam or sandy clay. In some places the bedrock is calcareous sandstone underlain by shaly material; in others the calcareous sandstone appears to have weathered to a soft, finely laminated, shaly bed that is brown, red, and yellow.

The natural fertility and organic-matter content are moderate. Reaction is medium to strongly acid. The soil is permeable to both roots and moisture.

Use and management.—Practically all of this soil is under cut-over forest consisting of mixed pines and deciduous hardwoods. Its strong slope, shallow depth to bedrock, and moderate natural fertility make it poorly suited both to crops requiring tillage and to pasture. Most areas are best retained as forest land. Areas that must be used for pasture need to be handled carefully, since the soil erodes easily. More desirable grasses and legumes can be produced in pastures if the fertility is improved and maintained. Under favorable management a carrying capacity of approximately 60 cow-acre-days can be maintained.

Tellico loam, eroded steep phase (25+% slopes) (TL).—This soil differs from the eroded hilly phase in possessing stronger slopes and in having lost a notable part of its original surface soil through erosion. Slopes range from approximately 25 to 50 percent. The many areas occur throughout the Tellico-Neubert soil association; they range from 10 to 200 acres or more in size. In most places the plow layer consists of a mixture of original surface and subsoil material; it is a light reddish-brown to reddish-brown loam or clay loam. Calcareous sandstone bedrock or weathered shale is at depths of 1½ to 8 feet.

The natural fertility and content of organic matter are low, and the reaction is medium to strongly acid. The tilth of the plow layer is less favorable than that of the uneroded phase. On the more eroded patches tilth is unfavorable. The texture on the more exposed parts may be clay loam or sandy clay. Most of the soil material is moderately permeable to moisture, but its capacity for holding moisture available to plants is limited to some extent by the clayey texture and shallow depth to bedrock.

Use and management.—All of this soil has been cleared and cropped at some time. Part is now under volunteer Virginia and shortleaf pines. A considerable acreage is idle; it supports an irregular and sparse growth of broomsedge, briers, sassafras, and other brush. About half of the total acreage is used for unimproved pasture, and a small part is cropped. Little fertilization is practiced and yields are usually low.

This soil is poorly suited to crops or pasture because it has strong slope and is shallow to bedrock. Reforestation is apparently the best way to reclaim the soil. Areas that must be used for pasture will require heavy fertilization, proper seeding, and careful management to maintain grazing vegetation and protect the soil from erosion. In most places, except perhaps on the north-facing slopes, the soil is rather droughty and good growth of pasture is limited to rainy periods during the growing season. Under favorable conditions the carrying capacity for pasture may be about 55 cow-acre days.

Tellico clay loam, severely eroded steep phase (25+% slopes) (TG).—This soil comprises areas, formerly of Tellico loam, steep phase, that have lost practically all of the original surface soil and in places part of the subsoil as a result of erosion. Gullies are common, and some are too large to be crossed with farm machinery. The numerous tracts occupy steep slopes throughout the Tellico-Neubert soil association. In general they are not so large as those of the other steep phases of the Tellico soils The plow layer consists of dark-red

clay loam or sandy clay that is firm but moderately friable. Limestone bedrock is at depths of 1 to 8 feet.

The natural fertility and organic-matter content are low and the reaction is strongly acid. The soil material is permeable to roots, but slow infiltration causes runoff to develop quickly during rains.

Use and management.—All areas have been cleared and cropped at some time. Some are now under a volunteer stand of Virginia and shortleaf pines. About half are idle and have an irregular sparse growth of broomsedge and brush. Some of the soil is used for unimproved pasture. Little fertilizer and lime have been applied. The carrying capacity is very low. Strong slope, shallow depth to bedrock, low fertility, and unfavorable tilth make this soil poorly suited to crops or pasture. Its best use is for forest.

Tellico loam, rolling phase (5–12% slopes) (TN).—This is a moderately fertile well-drained red soil developed over calcareous sandstone. Most of the areas are on the high ridge crests in the Tellico-Neubert soil association. The dominant slope range is 5 to 12 percent, but some slopes may be as low as 2 percent. Many areas are narrow, although some are broad enough to make up fairly large fields. This phase is but a small part of the rolling Tellico soils. Most of the rolling acreage of Tellico loam has been cleared. It has eroded because of the clearing and is now mapped chiefly as Tellico loam, eroded rolling phase or as Tellico clay loam, severely eroded rolling phase. Practically all of the Tellico loam, rolling phase, is under cut-over mixed deciduous and pine forest.

Profile description:

0 to 7 inches, light reddish-brown loam or fine sandy loam.
7 to 26 inches, dark reddish-brown or dark-red friable but firm sandy clay or sandy clay loam.
26 to 40 inches+, red or dark-red, grading to lighter red, firm but friable sandy clay or sandy clay loam; calcareous sandstone bedrock at depths of 4 to 12 feet.

In some places the subsoil is more nearly a silty clay loam than a sandy clay loam. In other places the bedrock is finely laminated brown, red, and yellow weak-structured shale.

The natural fertility of this soil is moderate and the organic-matter content is low. The reaction is medium to strongly acid. Internal drainage is moderate to rapid and infiltration of moisture is fairly rapid. The entire soil is permeable both to roots and moisture, and the capacity for holding moisture available to plants is fairly high.

Use and management.—Although most of this soil is under native forest, it is considered well suited to a wide variety of crops, especially vegetables. It is favored for truck crops, chiefly because of the early date that they are ready for market. In addition, the tilth is exceptionally good for truck crops, and the vegetables grown are of high quality. The soil is easily worked and dries out enough to permit field operations a short time after rains. Good structure is easy to maintain because the soil is sandy. Corn, small grains, and a wide variety of hay and pasture crops, including alfalfa and red clover, are also well suited.

Many row crops can be grown, but short rotations are not suitable because slopes are strong enough to make erosion a hazard in cultivated fields. In most areas, however, 3- or 4-year rotation can be

used if supplementary measures are taken to control runoff. Where at all feasible, field work should be done on the contour. Strip cropping may be a practical way of restraining erosion. In some places methods of diverting the runoff that comes from higher parts will aid in stabilizing the lower, more sloping parts. If high productivity is to be maintained, all areas will require moderately heavy fertilization, liming, and addition of organic matter. Under adequate management fairly high yields of practically all crops can be expected; corn yields about 50 bushels, wheat 20 bushels, and alfalfa 2.8 tons an acre. This soil is well suited to pasture, although somewhat less so than the Dewey, Decatur, and Emory soils. Bluegrass, white clover, orchard grass, and Bermuda grass produce good pasture where fertility is maintained.

Tellico loam, eroded rolling phase (5–12% slopes) (Tk).—This phase consists of those areas, formerly of Tellico loam, rolling phase, that have been so eroded that the plow layer now consists of a mixture of original surface soil and subsoil material. It is the most extensive of the rolling Tellico soils and occupies much of the ridge tops, but on the whole the areas are rather narrow. In places, however, they are fairly broad and include moderately large fields. All are within the Tellico-Neubert soil association. Approximately half of the original surface soil has been lost through erosion. In most places the plow layer is a reddish-brown loam or fine sandy clay loam, and the subsoil, a dark-red friable sandy clay. Calcareous sandstone bedrock or weak-structured shale is at depths of 4 to 12 feet.

The natural fertility and organic-matter content are not high. The reaction is medium to strongly acid. The soil is easily permeable both to roots and moisture, and its capacity for holding moisture available to plants is moderately high.

Use and management.—All of this soil has been cleared and nearly all of it has been cropped at some time. A great part is used for crops, chief among which are corn, vegetables, hay, and small grains. Rotations are short, and row crops are grown at rather frequent intervals. Corn and small grains commonly receive 100 to 150 pounds of 20-percent phosphate or mixed fertilizer an acre. Lime has been applied to much of the acreage at the rate of 2 or 3 tons an acre. The acreage in hay and pasture crops has received this treatment more consistently than acreages in other crops. Vegetables are fertilized rather heavily; they receive 500 to 1,000 pounds of mixed fertilizer an acre. Some manure is used. It is applied irregularly, but mostly for the high value crops. Under ordinary conditions corn yields 20 bushels, wheat 10 bushels, and lespedeza 0.8 ton an acre.

The smooth surface, favorable tilth and moisture relations, and ability to respond to fertilization make this soil well suited to a wide variety of crops. The soil is especially desirable for vegetables, which mature early and are of a good quality. It has tilth suitable for the intensive cultivation needed in growing vegetables and is dry enough to work shortly after rains. Other crops common to this region are suitable; but if good yields are to be obtained, adequate fertilization is necessary. Organic matter, phosphorus, and lime are especially needed. The moderately strong slope and easy erodibility make moderately long rotations necessary if runoff is to be restrained. Under a high level of management, corn will yield approximately 40 bushels,

wheat 19 bushels, and alfalfa 2.6 tons an acre. Where fairly high fertility is established, pastures of the more desirable grasses and legumes will have a carrying capacity of 85 cow-acre-days.

Tellico clay loam, severely eroded rolling phase (5–12% slopes) (TF).—This phase consists of areas formerly occupied by Tellico loam, rolling phase, from which erosion has removed practically all of the surface soil and, in places, part of the subsoil. There are a few gullies, most of which can be crossed with farm machinery. Practically all of the areas are on high ridge crests in the Tellico-Neubert soil association; they generally range from 3 to 15 acres in size. The plow layer consists of dark-red firm but friable clay loam and is similar to the subsoil material. Calcareous sandstone bedrock or shaly material is at depths of 3 to 10 feet.

The natural fertility and content of organic matter are low, and the reaction is medium to strongly acid. Infiltration of moisture is slow, and tilth of the plow layer unfavorable. Roots penetrate the entire soil without great difficulty. The capacity for holding moisture available to plants is low. The soil becomes hard and dry within a short time after rains.

Use and management.—All of this soil has been cleared and cropped at some time. Much of it is now idle or in unimproved pasture. A small part of the idle land has a volunteer stand of shortleaf and Virginia pines, and the rest supports a variable cover of broomsedge, briers, and sassafras. The vegetation on the pastured areas is chiefly broomsedge and lespedeza. The small acreage cropped is used chiefly for corn and hay. Fertilization is not heavy, and few areas are being improved in productivity. Crop yields are usually low.

Poor tilth, unfavorable moisture relations, and low fertility limit the usefulness of this soil. Productivity is low, and the soil is difficult to work and conserve. Where the fertility and tilth are improved and supplementary measures are taken to control runoff, the soil is capable of producing fair yields of such crops as small grains, hay, and corn. It is not well suited to truck crops, mainly because it has unfavorable tilth and a low moisture-holding capacity that would be difficult to improve. Long rotations consisting chiefly of close-growing small grains and hays are required for improving productivity or keeping it at a high level. Under good management oats will yield 23 bushels and alfalfa about 1.9 tons an acre.

Tyler silt loam (0–2% slopes) (TP).—This is a gray very poorly drained soil on stream terraces and local alluvium. Its parent material came predominantly from Montevallo, Muskingum, and Lehew soils. It is much like the Guthrie soil and is locally known as "crawfish" land. It has a nearly level or very gently sloping surface.

Profile description:

0 to 6 inches, gray friable silt loam.
6 to 12 inches, mottled gray and yellow silty clay loam.
12 to 36 inches +, gray very firm silty clay with mottlings of yellow; bedrock, chiefly shale, at widely variable depths ranging approximately from 5 to 40 feet.

The natural fertility and organic matter-content are very low. The reaction is medium to strongly acid. Internal drainage is very slow, and moisture conditions fluctuate. During wet periods the water table is at or near the surface, and during the driest periods the soil is hard

and the water table is several feet below the surface. The subsoil is not easily penetrated by either roots or moisture.

Use and management.—Much of this soil is cleared. A great part is used for pasture. Some acreage is in corn, sorghum, soybeans, and lespedeza and redtop hay. Little fertilization is practiced, and crop yields are low.

This soil is poorly suited to crops because of unfavorable moisture conditions, poor tilth, and low fertility. Its productivity and range of suitability could be improved by artificial drainage, but this may not be practical. If drainage is improved and adequate fertilizer and lime are applied, it is capable of producing pasture and certain hay crops. Under favorable conditions pasture can be expected to have a carrying capacity of 80 cow-acre-days.

Waynesboro loam, eroded undulating phase (2–5% slopes) (WD).—This is a well-drained soil derived from mixed alluvium on high stream terraces. It differs from the Cumberland soil chiefly in having a lighter brown surface layer and a noticeable amount of sandy material throughout. It is associated with Nolichucky and Cumberland soils on the high stream terraces along the Holston, French Broad, and Tennessee Rivers. These terraces rise 50 to 120 feet above the river channels. A great part of this phase has been so eroded that the plow layer now consists of a mixture of surface soil and subsoil material.

Profile description:

0 to 6 inches, grayish-brown loam.
6 to 18 inches, yellowish-brown, grading to brown, friable silty clay loam or clay loam.
18 inches +, red, firm but friable silty clay loam or sandy clay; irregular beds of gravelly material may be at depths of 4 to 5 feet; bedrock at 5 to about 40 feet.

In places the surface layer is fine sandy loam. There are a few cobblestones and pieces of gravel. Indicated on the map by appropriate symbols are areas in which these stones are abundant enough to interfere materially with cultivation.

The soil is moderately fertile and its content of organic matter is fair. The reaction is medium to strongly acid. Internal drainage is moderate. The soil is permeable to both roots and moisture, although the subsoil is firm enough to impede percolation somewhat. The soil has a fair to good capacity for holding moisture available to plants.

Use and management.—Nearly all of this soil has been cleared and cultivated at some time and much of it is now used for crops. A small part is under pasture. Corn, small grains, hay, vegetables, and tobacco are the chief crops grown, and 2- to 4-year rotations prevail. Much of the acreage receives from 2 to 3 tons of lime an acre at intervals of 6 to 10 years. Corn and small grains commonly receive 75 to 125 pounds an acre of 20-percent phosphate or a mixed fertilizer. Vegetables and tobacco are fertilized at a heavier rate; the applications range from 300 to 500 pounds an acre of 2–10–2 or 2–10–4, along with light to moderate applications of manure. Alfalfa land is treated with lime and 200 to 500 pounds of fertilizer at the time of seeding. Some manure is commonly used in establishing this crop. Under ordinary conditions corn yields about 30 bushels, wheat 14 bushels, and alfalfa 2.7 tons an acre.

This soil is well suited to crops requiring tillage, as it responds well to fertilization and is easily worked and conserved. Organic matter as well as plant nutrients and lime must be added to maintain fertility. Rotations lasting 3 or 4 years are suitable, but the more sloping parts will require some special attention if runoff is to be controlled adequately. Good tilth is difficult to maintain only in the more eroded parts. Avoid cultivating the eroded parts when the soil is too wet.

Under a high level of management, corn will yield 53 bushels, wheat 24 bushels, and alfalfa about 3.4 tons an acre. This soil will produce heavy yields of good quality tobacco and vegetables under good management. Where care is used to maintain high fertility, pastures produce the more desirable grasses and legumes, including red clover, alfalfa, white clover, and bluegrass. Under favorable conditions pastures should have a carrying capacity of about 120 cow-acre-days.

Waynesboro loam, eroded rolling phase (5–12% slopes) (Wc.)—This soil differs from the eroded undulating phase chiefly in having stronger slopes. The plow layer may be a little thinner on the average, and eroded patches are more common. The depth to gravelly material or to bedrock is somewhat less. The soil is associated with Nolichucky, Cumberland, and other Waynesboro soils in the Cumberland-Huntington soil association.

The surface 5 inches is grayish-brown to reddish-brown friable loam or fine sandy loam. Below this and extending to a depth of about 12 inches is yellowish-brown or dark yellowish-brown firm but friable silty clay loam or clay loam. This material is underlain by red firm but friable clay or sandy clay. On the more exposed knobs or slopes practically all of the surface soil may be lacking and the plow layer is the red firm clayey material characteristic of the subsoil. Cobblestones or pieces of gravel occur in places. Irregular gravel beds may occur at depths ranging from 30 to 50 inches. Limestone or shale bedrock is at 4 to 30 feet. There are a few bedrock outcrops.

The natural fertility is moderate, and the content of the organic matter rather low. The reaction is medium to strongly acid. Internal drainage is moderate. The soil is permeable to both roots and moisture, although infiltration is somewhat impeded by the firm clay loam subsoil. The moderately strong slope and rather shallow depth to the firm subsoil cause runoff to develop rapidly during rains.

Use and management.—Much of this soil has been cleared and cropped at some time. A large part of the cleared area is now used for corn, small grains, and hay. A small acreage is used for vegetables and tobacco, and some is in pasture. Rotations that last 3 to 5 years prevail. Fertilization is the same as for the eroded undulating phase. Yields may be a little lower.

This soil is suited to crops requiring tillage; but because of its rather strong slope and somewhat impeded absorption, some care is required to restrain runoff. Moderately long rotations are therefore necessary, and close-growing cover should be maintained as long as feasible. The soil is suitable for practically all crops commonly grown, including alfalfa, tobacco, and truck crops. Nevertheless, it is less suitable for row crops than the undulating phase because the hazard of erosion is greater and tillage is more difficult. The more desirable legumes

and grasses for pasture are suited to this soil. Under a high level of management corn yields about 50 bushels, wheat 22 bushels, and alfalfa 3.1 tons an acre. The carrying capacity of pasture that receives a high level of management is about 110 cow-acre-days.

Waynesboro loam, eroded hilly phase (12–25% slopes) (WB).—This phase is made up of eroded hilly areas of Waynesboro loam. A large part of it occurs as narrow strips on rather strong slopes below smoother areas of Waynesboro soils. These strips, to a great extent, occupy stream terrace escarpments. Practically all of the acreage is in the Cumberland-Huntington soil association. It has been so much eroded that approximately half the original surface soil has been lost and the plow layer now consists of a mixture of the original surface soil and subsoil material.

In most places the 4- or 5-inch plow layer is grayish-brown or reddish-brown loam or clay loam. The reddish, firm, clayey subsoil is at depths of 8 to 15 inches. The gravelly layer, or bedrock, is at variable depths; in some places it may be as much as 20 feet deep and in others it is exposed at the surface. The more exposed patches are on the steeper parts of the slope. Many areas have lost all of the original surface layer, and in these the plow layer consists of reddish-brown firm clayey subsoil material. In some areas pieces of gravel or cobblestones interfere materially with cultivation.

Included with this phase because of their small acreage and their similarity in many characteristics and suitabilities, are areas of hilly Nolichucky soil. These inclusions have a clay loam or fine sandy clay loam surface layer and a light-red or yellow firm clay loam or clay subsoil.

The natural fertility and organic-matter content of Waynesboro loam, eroded hilly phase, are low. The reaction is medium to strongly acid. The soil material is permeable to both roots and moisture. Because of the shallow depth to the firm clayey subsoil, however, infiltration is rather slow in most places and runoff develops rapidly during rains. The moisture-holding capacity of the more eroded parts is limited, and the soil is therefore droughty during drier parts of the growing season.

Use and management.—Practically all of this soil has been cleared and cropped at some time. Much is now used for hay and pasture and a small part for corn and small grains. Lespedeza and alfalfa are the chief hay crops, and lespedeza, redtop, hop clover, and white clover the principal pasture vegetation. Much of the acreage has been treated with lime, but fertilization with either barnyard manure or commercial fertilizer is generally light. Crops are not rotated systematically. Under ordinary conditions crop yields are low.

This soil is suited to both tilled crops and pasture. Its management requirements are rather exacting, however, and its range of suitability for crops is limited, chiefly because of its strong slope and somewhat restricted moisture supply. It is difficult to work because of the slope, and in places because of the heaviness of the plow layer. If the soil is to be maintained, long rotations consisting mainly of close-growing small grains and hay and pasture crops are required. Great care is necessary in tillage, and cultivation should be done on the contour.

Adequate fertilization, including addition of organic matter and lime, is necessary to bring productivity to a fairly high level. Under good management wheat will yield about 19 bushels, lespedeza 1½ tons, and alfalfa 2.7 tons an acre. Where the soil is kept fertile, pasture consists of the more desirable grasses and legumes and produces about 95 cow-acre-days of grazing.

Waynesboro clay loam, severely eroded hilly phase (12–25% slopes) (WA).—This soil consists of those areas of Waynesboro soil that are hilly and that have been so eroded that practically all of the original surface soil and, in places, part of the subsoil have been lost. Gullies occur in a few places, and some are too large to be obliterated by tillage. A few too large to be crossed with farm machinery are indicated on the soil map by symbol.

A great part of this phase lies as narrow strips on strong slopes below and adjacent to the smoother areas of Waynesboro soils. Practically all of this soil is in Cumberland-Huntington soil association. The plow layer consists chiefly of reddish firm but friable clay loam or sandy clay material. The depth to gravel or bedrock is as much as 15 feet, but in a few places bedrock may outcrop.

The natural fertility and content of organic matter are low, and the reaction is medium to strongly acid.

Use and management.—All of this soil has been cleared and cropped at some time. Much is now used for pasture but some is idle. The vegetation consists of broomsedge, some lespedeza intermixed, and a variable growth of briers, sassafras, and other brush. The pasture is of fair quality in many places. A small part of the soil may be cultivated, but its yield and the carrying capacity are low when it is used for pasture.

Chiefly because of strong slope and severe erosion, this soil is not suited to crops requiring tillage. Productivity is low and workability and conservation are difficult. Where care is taken to improve and maintain fertility fair grazing can be obtained, though droughtiness limits the carrying capacity. Under favorable conditions pasture may have a carrying capacity of about 60 cow-acre-days. The more eroded parts of this soil can well be reforested with such trees as shortleaf and loblolly pines. After many years in forest, it may be feasible to return the soil to production of small grains, hay, and pasture.

Wolftever silty clay loam, eroded undulating phase (2–5% slopes) (WF).—This is a light-brown moderately well drained soil on low stream terraces that consist of mixed general alluvium. The tracts are along the Holston, French Broad, and Tennessee Rivers, usually 5 to 15 feet above the adjoining first bottoms. They occupy positions similar to those of the sandy Sequatchie soil. The soil is characterized by its firm to almost tight subsoil. A great part of the acreage has been so eroded that the plow layer in most places consists of a mixture of surface soil and subsoil material.

Profile description:

0 to 5 inches, light-brown or light yellowish-brown silty clay loam.
5 to 20 inches, light yellowish-brown firm to very firm silty clay loam.

20 to 36 inches, mottled brownish-yellow, gray, and brown firm silty clay loam or silty clay; depth to bedrock varies from 10 to 40 feet; a notable amount of mica and, in a few places, fine sand grains occur through the entire soil.

A small part of this phase that has not been materially eroded has a surface layer of a light-brown silt loam about 9 inches thick.

The natural fertility is moderate, and the soil has a fair content of organic matter. Its reaction is medium acid. Internal drainage is somewhat impaired by the firm subsoil. Many of the areas are therefore rather droughty, since their capacity for holding moisture available to plants is limited. The development of roots is impeded during dry periods. Some areas, however, have a less tight subsoil and are better suited to plant growth. Some may be subject to occasional flooding, but this hazard has been lessened by construction of flood-control dams upstream from Knox County on the Holston and French Broad Rivers. A few areas of Wolftever soil were permanently inundated by the Fort Loudon Reservoir.

Use and management.—Practically all of this soil has been cleared and cropped. It is used mainly for corn, small grains, and hay. The chief hay crop is lespedeza. Rotations range from 2 to 3 years in length. Corn and small grains receive some fertilization, and most of the acreage probably has been limed. Under ordinary conditions corn yields about 25 bushels and wheat 14 bushels an acre. Pasture in most places is of fair quality and has a carrying capacity of about 80 cow-acre-days.

This soil is suited to a great variety of crops, and much of the acreage can be used in fairly short rotations. The more sloping parts require careful tillage, as runoff develops quickly because of the slow permeability of the compact subsoil. The soil responds well to fertilization, and most areas are easily worked where fertility is brought to a high level. Corn can be expected to yield about 42 bushels and lespedeza about 1.5 tons an acre. Pasture consisting of the more desirable legumes and grasses will produce 125 cow-acre-days of grazing where the fertility is adequate and weedy growth is suppressed. The droughtiness, where the subsoil is more compact, commonly limits the yields of late-season crops such as corn, lespedeza, and late summer pasture.

Wolftever silty clay loam, eroded rolling phase (5–12% slopes) (WE).—This phase comprises those eroded areas, formerly of Wolftever silt loam, rolling phase, that have a rolling surface. Much of it lies as narrow strips adjacent to and below larger areas of the smoother Wolftever soil. A great many of these strips are low stream-terrace escarpments.

The surface layer varies according to the degree of erosion. On the small acreage not materially eroded it is light-brown silt loam 6 to 8 inches thick. It is underlain to depths of 12 to 18 inches by light yellowish-brown firm to very firm silty clay loam or clay loam. Below this layer is mottled brownish-yellow, gray, and brown firm silt loam.

Considerable areas have been so eroded that the plow layer now consists of original subsoil material. It is predominantly a yellowish-

brown silty clay loam. There are also some areas where practically all of the surface layer has been lost. In these places the plow layer consists of brownish-yellow silty clay. A noticeable amount of mica flakes occurs throughout the entire depth of those areas along the French Broad and Tennessee Rivers, and in places some sand is intermixed.

The natural fertility is moderate to fair, and the amount of organic matter is low. The reaction is medium to strongly acid. Areas that are moderate to severely eroded do not absorb moisture rapidly, but the least eroded places have fairly good moisture relations. Tilth conditions generally are fair to poor, as the clayey subsoil is not easily tilled. The soil puddles readily if cultivated when too moist and becomes hard when dry.

Use and management.—Practically all of this soil has been cleared and cropped. Much of it is now used for small grains, hay, and corn. Its productivity is fair, though it varies according to the effect erosion has had on texture and consistence of the plow layer. Light fertilization is common and lime has been applied to part of the acreage.

The soil is considered suitable for some crops requiring tillage, but its management requirements are rather exacting because of the slope, unfavorable tilth, and the ease with which runoff accumulates during rains. Where feasible, it should be used in a long rotation or for permanent pasture. Tillage should be on the contour, and in places diversion of runoff from adjacent higher lying areas will help prevent erosion on this soil. The best crops for this eroded rolling phase are close-growing small grains and hay and pasture. Of the hay crops, lespedeza, red clover, alfalfa, and such grasses as timothy and orchard grass are preferable. Truck crops and probably tobacco are not well suited. If the soil is carefully cultivated and its fertility is kept at a high level, oats will yield 47 bushels and lespedeza 1.3 tons an acre. Under favorable conditions the carrying capacity of pasture is about 110 cow-acre-days. Yields will not be high on the more eroded parts, since their droughtiness affects the growth of plants during dry periods.

USE AND MANAGEMENT[7] REQUIREMENTS OF GROUPS OF SOILS

Each soil as described in the preceding section is distinguished from all of the others by one or more differences in properties. Many, however, have about the same degree of use suitability for crops, pasture, forest, or a combination of these. They therefore can be designated as First-, Second-, Third-, Fourth-, or Fifth-class soils, as explained in the section on Use Suitability Groups. The degree of suitability is ap-

[7] The term "soil use" refers to broad farm uses such as for (1) crops that require tillage, (2) permanent pasture, and (3) forests. The term "soil management" refers to such practices as (1) choice and rotation of crops, (2) application of soil amendments, such as lime, commercial fertilizers, manure, and crop residues, (3) tillage, and (4) engineering measures for the control of water on the land.

praised by evaluating the productivity, workability, and conservability of the soil.[8]

Some soils that have about the same use suitability may be so different in characteristics that they require entirely different management practices. For example, two soils, one characterized by a nearly level surface and slow drainage and the other by a strong slope and good drainage, may have the same degree of suitability for crops but require different management for those crops. Other soils, however, are sufficiently alike to require approximately the same management.

For the purpose of discussing or comparing soils from the standpoint of proper management, they can be grouped according to similarities in their characteristics that determine their management requirements. In the following pages the soils of Knox County are grouped in this way, the features of each group that are important in determining management requirements are stated, and the proper management for each group is discussed.

In groups 1–A to 1–N are soils considered suitable for crops requiring tillage, as well as for pasture or forest; in groups 2–A to 2–E are soils not well suited to crops but suited to pasture; and in group 3–A are soils not well suited to either crops or pasture.

The color scheme, or color grouping, on the soil map shows the distribution of these 20 management groups. In order to restrict the number of colors on the map, a few of the more similar management groups are represented by the same color. The map legend shows the management groups, and the colors that represent them on the map.

The management requirements of soils in each group are discussed with respect to two broad uses: (1) Crops that require tillage; and, (2) permanent pasture. Management requirements are discussed in terms of one or more crop rotations considered well suited to the soils. The management of the soil for one crop in the rotation generally affects the production of other crops in that rotation. The management requirements of the soil for each crop, therefore, are dependent not only on the properties of the soil and characteristics of the crop but also on the management practiced on other crops in the rotation.

Experimental data on which to base recommendations for the use or management of many of the soils of the county are not entirely adequate. Also, determining the best use and management on a particular farm involves consideration of many conditions that apply only to that particular farm. The general recommendations made in this report for any given kind of soil therefore should be considered in the light of conditions on the individual farm, and frequently will need to be modified to meet those conditions. The material in this sec-

[8] Productivity, as used here, refers to the capacity of a soil to produce crops and pasture plants; this capacity is dependent not only upon a proper supply of nutrients but also upon such air and water relations as will make use of these nutrients possible. Workability refers to the ease of tillage, harvesting, and other field operations. Texture, structure, consistence, stoniness, and degree of slope are important properties that affect workability. Conservability refers to the ease with which the productivity and workability of the soil can be maintained.

tion is limited chiefly to a discussion of the deficiencies of the 20 different groups of soils and some of the practices that appear most widely applicable to each of these groups.

GROUP 1–A

The soils of group 1–A and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Congaree fine sandy loam	2
Congaree fine sandy loam, low-bottom phase	1
Congaree silt loam	1
Congaree silt loam, low-bottom phase	1
Emory and Abernathy silt loams	1
Huntington silt loam	1
Huntington silt loam, low-bottom phase	1
Staser silt loam	1
Staser fine sandy loam	2
Staser fine sandy loam, low-bottom phase	1

[1] Figures indicate soil class—First- and Second-class soils as described in section on Use Suitability Groups.

In group 1–A are well-drained soils on the bottom lands and in depressions. They are nearly level, fertile, and relatively free of stone or rock outcrops. Under natural conditions they are subject to overflow, but the great part of their acreage, which is along the Holston, French Broad, Clinch, and Tennessee Rivers, is now at least partly protected by flood-control dams upstream on these rivers. Except for flood hazard, moisture relations are notably favorable. Runoff is low, the capacity for holding moisture available to plants is high, and roots can penetrate to great depths. All of the soils have favorable tilth. They retain plant nutrients and organic matter well, and though naturally productive, they can be expected to give some response to proper fertilization.

Soils of this group are the least exacting in their management requirements. They are naturally productive and are easily worked and conserved. They are suited to a wide variety of crops, but the low-bottom phases are too susceptible to overflow to be suited to alfalfa, fall-sown small grains, or high-value crops such as tobacco and truck crops. Although row crops can be grown almost continuously, a short rotation is desirable under most conditions. A corn-hay or a corn-small grain-hay rotation should be well suited. Use of a winter cover crop, seeded following a row crop and turned under the following spring, is a good practice. This is especially suitable where row crops are grown practically every year. A legume cover crop such as crimson clover is to be preferred where the row crop allows proper seeding of the legume in the fall.

Phosphorus and potash are probably the chief plant nutrients needed,[9] although some areas are deficient in lime. Alfalfa will respond to borax. Where row crops are grown intensively, some nitrogen in addition to that supplied by the legume green-manure crop will be beneficial.

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[9] See the county agricultural agent regarding testing of soils for available plant nutrients and for specific information about the types and amounts of fertilizer.

Tillage operations are generally easy because of the good tilth and nearly level slope of these soils. Runoff is not an erosion hazard. Spring field work is usually delayed longer than on the more permeable, better drained, higher lying soils, although the fine sandy loam types of these bottom land soils can be worked shortly after rains. On the bottom lands, soils may be tilled under a wide range of moisture conditions with little or no bad effect.

All of these soils are productive of desirable pasture grasses and legumes, as they are fertile and have good to very good moisture relations during much of the grazing season. Weeds and brushy growth commonly encroach rapidly, so mowing or other means of control is required if pasture of high quality is to be maintained. Pastures will respond to applications of phosphorus, and some areas may need lime.

GROUP 1–B

The soils of group 1–B and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Chewacla silt loam	2
Hamblen fine sandy loam	2
Hamblen silt loam	2
Lindside silt loam	2
Ooltewah silt loam	2

[1] Figures indicate soil class—Second-class soils, as discussed in section on Use Suitability Groups.

This group consists of imperfectly drained soils on first bottoms and stream terraces and in depressions. The soils are nearly level, high in fertility, and relatively free of stone or rock outcrops. They differ from those of group 1–A chiefly in being less well drained and somewhat more susceptible to overflow, although flood-control dams have reduced this hazard on the areas along the rivers.

These soils generally are too wet for alfalfa, tobacco, and some truck crops; and the abundant moisture and relatively large supply of nitrogen make most areas poorly suited to the commonly grown small grains. Accordingly, the soils are restricted in their range of suitability. Among the better suited crops are corn, soybeans, certain late-season truck crops, and such hay and pasture crops as redtop, timothy, bluegrass, Bermuda-grass, white clover, lespedeza, and alsike clover.

All of these soils are well suited to intensive cropping, and if their fertility is maintained, row crops can be grown on them many years in succession. Phosphorus and potash are the chief plant nutrients required. Seeding winter cover crops (legumes where feasible) and plowing them under as green manure in the spring should prove beneficial where row crops are grown several years in succession. The need for adding organic matter is not as great as for most other soils of the county. Artificial drainage will improve the productivity and range of suitability for many areas. The practicability of drainage will depend on the need for soils of wider suitability, the cost of installation, the expected productivity increase, and other factors.

Field operations are more restricted on these soils than on the better drained ones. Accordingly, spring operations are delayed in some years to great disadvantage, and retarded harvesting occasionally may cause crops to deteriorate.

The soils of this group are among the most desirable for pasture, as they are fertile and their moisture relations favor the growth of pasture plants through much of the drier part of the growing season. Weeds grow abundantly, and good pasture management requires that they be suppressed or eradicated. Many areas can be improved if the excess vegetation is mowed periodically during the grazing season.

GROUP 1-C

The soils of group 1-C and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Camp silt loam	2
Emory silt loam, undulating phase	1
Emory silt loam, rolling phase	1
Greendale silt loam, undulating phase	2
Greendale cherty silt loam, undulating phase	3
Neubert loam, undulating phase	1
Neubert loam, rolling phase	2
Roane silt loam	2
Sequatchie fine sandy loam	2

[1] Figures denote soil class—First- and Second-class soils, as described in section on Use Suitability Groups.

The soils of this group occur on low stream terraces or local alluvium, chiefly of limestone origin. They are undulating to rolling, well-drained, deep to bedrock, friable, permeable, and medium to strongly acid. Though fertility ranges from moderately low for the cherty Greendale and Roane areas to high for the Emory soils, all respond well to good management. Because of their position on low stream terraces and local alluvium, most of these soils have relatively favorable moisture conditions for late-season crops. They have good tilth and, except for the cherty Greendale and Roane soils, are nearly free of stones and rock outcrops.

All of these soils are suited to a wide variety of crops, including corn, tobacco, potatoes, truck crops, melons, small grains, alfalfa, red clover, lespedeza, timothy, orchard grass, and other desirable pasture grasses and legumes. They are suitable for relatively intensive use, although row crops should not be grown continuously on the less fertile soils and the more sloping parts. In general, however, all the soils are capable of supporting 2- to 3-year rotations if their fertility is improved and maintained. A corn, wheat, red clover rotation is practical, and any of the truck crops, melons, tobacco, or potatoes can be substituted for the corn. Alfalfa can be substituted for the red clover, providing it is feasible to lengthen the rotation to include this crop. On some farms row crops may be grown annually on the better suited areas. If this is done, the row crop should be followed consistently by a winter cover crop, and where practical, by such legume cover crops as crimson clover.

These soils give excellent response to proper fertilization, even though many of them are relatively fertile in their natural state. Nitrogen fertilizer is a general requirement if legumes are not used to supply nitrogen. Phosphorus and potash are required for high yields, and lime for legumes and grasses. Maintenance of the organic-matter content is necessary, especially when the shorter rotations are used.

These soils are easily tilled. Except on the lowest areas field operations are not unduly delayed by rainy periods. Runoff is generally easy to control, but drainage channels are commonly entrenched deeply, or are apt to entrench if the floor of the channel is not protected by a well-maintained sod.

All of these soils are productive of pasture. The Emory, Camp and Neubert, which are more fertile and have very good moisture relations, are best for pasture. The most desirable pasture legumes and grasses will produce well if fertility is maintained and the proper quantity of lime is applied. Good pastures are somewhat more difficult to maintain on the cherty Greendale and Roane soils and the sandier areas of the Sequatchie soil than on others of this group. Weeds need to be suppressed or eradicated if high quality pasture is to be maintained. Weed growth is especially strong where fertility of the soils is kept high.

GROUP 1-D

The soils of group 1-D and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Leadvale and Cotaco loams, undulating phases	3
Leadvale and Cotaco loams, rolling phases	3
Leadvale and Whitesburg silt loams, undulating phases	2
Leadvale and Whitesburg silt loams, rolling phases	3

[1] Figures denote soil class—Second- and Third-class soils, as defined in the section on Use Suitability Groups.

This group consists of imperfectly drained soils on colluvium and local alluvium derived chiefly from Sequoia, Armuchee, Litz, Dandridge, Muskingum, and Lehew soils. The areas adjacent to the drainageways are very gently sloping and partly subject to short periods of overflow. Where farther removed, the areas are more sloping and have somewhat more rapid surface drainage as well as a firm subsoil. The soil materials are moderately to easily permeable, and their natural fertility is medium. Much of the acreage is medium to strongly acid, although some along the drainageways is not acid. Few stones are in the soils, and in most places bedrock is at a depth of several feet. Suitable physical characteristics and low position give these soils more favorable moisture relations during the drier parts of the growing season than the adjacent higher lying soils.

These soils are suited to many of the general farm crops, chiefly corn, soybeans, small grains, and legumes and grasses for hay and pasture. Alfalfa is not well suited. Truck crops, including potatoes, will produce better on some of the better drained higher lying soils. Moderately short rotations are feasible. The smoothest parts can support row crops several years in succession if fertility is kept high. Organic matter, phosphorus, and lime are the chief fertilizer needs, but potash also may be required. Some areas, especially those associated with soils underlain by calcareous shale, do not have a high requirement for lime.

Tillage is not difficult, although excessive moisture in spring usually delays field work. Field operations on the more sloping parts should be done on the contour in order to restrict erosion.

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These are especially favorable soils for pasture because they have better than average moisture conditions for late summer grazing. A great part of the acreage, however, requires fertilization, liming, and proper seeding if it is to provide a stand of good quality legumes and grasses. If grazing does not keep them down, weeds and excess herbage can be removed to advantage by mowing.

GROUP 1–E

The soils of group 1–E and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Alcoa silt loam, eroded undulating phase	1
Cumberland silty clay loam, eroded undulating phase	1
Decatur silt loam, undulating phase	1
Decatur silty clay loam, eroded undulating phase	1
Dewey silt loam, undulating phase	1
Dewey silty clay loam, eroded undulating phase	1
Etowah silt loam, undulating phase	1
Etowah silty clay loam, eroded undulating phase	1
Farragut silty clay loam, eroded undulating phase	1
Waynesboro loam, eroded undulating phase	2
Wolftever silty clay loam, eroded undulating phase	2

[1] Figures denote soil class—First- and Second-class soils, as described in the section on Use Suitability Groups.

This group consists chiefly of smooth, red, fertile soils of the limestone valleys and high stream terraces. Their surface soils are brown silt loam or silty clay loam and the subsoils for all but the Wolftever are red silty clay several feet thick over bedrock or gravel. Although the subsoils are firm and infiltration of moisture is somewhat retarded, these soils are sufficiently permeable for root development and have a fairly large capacity for holding plant nutrients and moisture available to plants. The content of organic matter in the surface soil is moderate, and the reaction is medium to strongly acid. In general these soils are considered the strongest of those on the uplands and stream terraces. The Wolftever soils have approximately the characteristics described, except they are on low stream terraces and their subsoil is yellowish-brown rather than red and a little firmer and less well drained.

This group has a wide range of suitability. Pasture and practically all crops produce well, and moderately short rotations can be used if management is good. The soils are especially good for alfalfa, small grains, and tobacco. Although these soils are well suited to truck crops, some of the more friable loamy soils are preferred for this use because they are more easily cultivated and more productive of root crops. Rotations lasting 3 or 4 years are considered adapted to the soils of group 1–E because they allow adequate alternation of row crops with close-growing crops. Suitable rotations are: (1) corn, a fall-sown small grain, and red clover or (2) corn, a small grain, and alfalfa for 3 years. Any of the commonly grown row crops can be substituted for corn. Because these soils have deep, firm subsoils, deep-rooted crops such as alfalfa are particularly valuable in improving them. Deep-rooted legumes improve soil permeability and can obtain moisture and plant nutrients from a relatively wide zone. When a fall-sown small grain does not follow the row crop, a

legume winter cover crop is valuable in holding the soil and maintaining the content of nitrogen and organic matter.

Although these are relatively fertile soils, adequate fertilization and liming are necessary if high productivity is to be maintained. Lime and phosphorus are needed, especially for legumes and grasses. Nitrogen, supplied either by legumes or by fertilizer, is particularly valuable to such crops as corn. Potash is generally needed for tobacco and the deep-rooted legumes, and boron is required for alfalfa.

Tillage is possible over a limited range of moisture conditions on the eroded phases and over a fairly wide range on the less eroded phases. Growing of grasses, deep-rooted legumes, and green-manure crops tends to improve tilth. Fall plowing is also considered a good way of improving tilth, provided it can be done without permitting excess runoff and consequent loss of soil material. Contour tillage aids in conserving soil moisture and soil material, and subsoiling increases the rate of moisture infiltration. To some extent, subsoiling has displaced plowing. Terracing is not an essential part of good soil management.

These soils are very well suited to pasture, although somewhat less so than those of groups 1–A to 1–D, which on the whole have the most favorable moisture relations. Fairly good pastures can be maintained without amendments, but excellent response is obtained where adequate lime and fertilizer, especially phosphorus fertilizer, are applied. Nitrogen is of value in establishing pasture, but after a stand is well started, the legumes should be able to maintain the supply. Where weeds or other excess vegetation develop, mowing will help maintain a pasture cover of high quality.

GROUP 1–F

The soils of group 1–F and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Alcoa silt loam, eroded rolling phase	2
Bolton silt loam, eroded rolling phase	2
Cumberland silty clay loam, eroded rolling phase	2
Cumberland gravelly fine sandy loam, eroded rolling phase	2
Decatur silt loam, rolling phase	1
Decatur silty clay loam, eroded rolling phase	2
Dewey silt loam, rolling phase	2
Dewey silty clay loam, eroded rolling phase	2
Etowah silty clay loam, eroded rolling phase	2
Farragut silty clay loam, eroded rolling phase	2
Waynesboro loam, eroded rolling phase	2

[1] Figures denote soil class—First- and Second-class soils, as defined in the section on Use Suitability Groups.

This group consists chiefly of the red fertile soils with a rolling surface that occur in the limestone valleys and on high stream terraces. The soils differ from those in group 1–E chiefly in having stronger slopes, dominantly 5 to 12 percent. In great part, the plow layer of these soils consists of a mixture of original surface soil and reddish subsoil material. The surface texture is therefore silty clay loam, or in the more eroded spots, silty clay. The subsoils are firm, predominantly reddish, silty clay, several feet thick over bedrock or

gravel, that somewhat retard infiltration of moisture. Nevertheless, these subsoils are sufficiently permeable to allow root development and have a fairly large capacity for holding both plant nutrients and moisture available to plants. The content of organic matter in the surface soils is moderate; it can be expected to be lower than that in the surface soils of group 1–E. The reaction is medium to strongly acid. These soils are usually considered strong, but because of their greater slope and erosion, somewhat less so than those of group 1–E.

Soils of this group have a relatively wide suitability for crops and pasture. They are suitable for practically all general farm crops; but their heavier plow layer and rather strong slope lower the suitability for truck crops and other crops grown in short rotations. The soils are very well suited to alfalfa and small grains, and to tobacco and corn in areas where row crops are not grown frequently. Observations indicate that 4- to 6-year rotations consisting of corn, a small grain, and alfalfa for 2 to 4 years are well suited. Winter cover crops should follow all cultivated crops. Where fall-sown small grains are not used, a legume green-manure crop such as crimson clover can well be substituted for them. Because these soils have deep firm subsoils, such deep-rooted crops as alfalfa are of particular value. The deep-rooted legumes improve soil permeability and are able to obtain moisture and plant nutrients from a relatively deep zone. Other common row crops can be substituted for corn. Red clover sown with a suitable grass and left for 2 years may be substituted for alfalfa.

Although the soils of this group are relatively fertile, they will respond to lime, phosphorus, and nitrogen. Lime and phosphorus are especially needed for legumes and grasses. Nitrogen, supplied either by legumes or fertilizer, is of considerable value for such crops as corn. Potash is generally needed, at least for deep-rooted legumes and tobacco. Alfalfa needs boron. Where barnyard manure is not available for use—particularly for use on row crops—green-manure crops will aid in maintaining high productivity.

Because soils of this group have a rather uniform silty clay loam texture, they are a little more difficult to keep in good tilth than much of the acreage in groups 1–A to 1–E. Tillage is limited by moisture conditions. The soils puddle when too moist and are hard to plow and lumpy when dry. Growing of grasses, deep-rooted legumes, and green-manure crops tends to improve the tilth, and fall plowing, by exposing the clods to freezing and thawing during winter, aids in developing the tilth needed for preparing a good seedbed in spring. Care is required to prevent erosion. Tillage and other field operations should be done on the contour where at all feasible, and it may be practical to divert excess water from higher lying areas. In some circumstances terraces may be practical. Terraces are not needed in general farming where 4- to 6-year rotations are used and close-growing crops occupy the soil a great part of the time. Some farmers practice subsoiling to improve the permeability of the soils, and to some extent this method has displaced plowing.

These soils are well suited to pasture, although somewhat less so than those of groups 1–A to 1–D, which have the most favorable moisture relations. Considering their greater erosion hazard, the soils of Group 1–F ordinarily should be used for pasture, as the sod

checks runoff and erosion. Much of the acreage will maintain fairly good pastures without amendments. If good pastures are to be established, adequate fertilization, especially with phosphorus and lime, is necessary. Nitrogen is of value in establishing pasture, but after the stand is well started the legumes should be able to maintain the nitrogen supply. Where weeds or other excess growth develops, mowing will aid in maintaining a pasture cover of high quality.

GROUP 1–G

The soils of group 1–G and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Fullerton silt loam, undulating phase	2
Fullerton silt loam, eroded undulating phase	2
Fullerton loam, undulating phase	2
Fullerton loam, eroded undulating phase	2
Jefferson and Montevallo loams, eroded undulating phases	3

[1] Figures denote soil class—Second- and Third-class soils, as described in the section on Use Suitability Groups.

The soils of this group are light-colored, well-drained, and except for the Jefferson and Montevallo soils, moderately deep to cherty limestone bedrock. The Jefferson and Montevallo soils are underlain by shale and are moderately deep to bedrock. All the soils are moderate to low in fertility and medium to strongly acid. The subsoils, though moderately firm, are permeable to both roots and moisture and have a fairly good capacity for holding moisture. The soils all have a smooth surface and good tilth throughout the plow layer.

These soils are suited to a wide variety of crops, including corn, small grains, hay, tobacco, and many vegetable crops. They are less well suited to the more exacting legumes and grasses, such as alfalfa, red clover, and timothy, than the soils of groups 1–E and 1–F. These crops, however, can be produced if high fertility is established. These soils have favorable tilth for many truck crops. They are more exacting in their management requirements than those of group 1–E, chiefly because of their lower natural fertility. Although suited to moderately short rotations, they require heavy fertilization if they are to maintain productivity and resist erosion losses. A rotation consisting of corn, a small grain, and then red clover and orchard grass for 2 or 3 years is well suited. Row crops such as tobacco and potatoes may replace the corn. Large applications of phosphorus, lime, and probably potash are necessary, especially for the legumes. Nitrogen must be added in relatively large amounts for row crops if high productivity is to be maintained. Green-manure crops should be a part of the rotation where organic matter cannot be supplied by applying barnyard manure.

Good tillage is easily maintained, and cultivation can be carried on over a fairly wide range of moisture conditions. The soils are somewhat susceptible to erosion, but adequate control is not difficult where they are not left fallow or in row crops for extended periods. Contour tillage may be a practical aid in restraining runoff on the more sloping parts. Terraces or other engineering devices for runoff control are not generally required unless a short rotation is to be used.

The soils of this group are suitable for pasture. Moderate to large amounts of lime, phosphorus, and probably potash will be needed to establish grass-legume pastures of high carrying capacity. White clover, bluegrass, orchard grass, and most other high quality pasture plants are more difficult to establish and maintain than on the more fertile soils. Weeds and brushy growth usually flourish where the pasture is brought to a high level of fertility, but can be mowed in most places.

GROUP 1–H

The soils of group 1–H and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Clarksville cherty silt loam, rolling phase	3
Clarksville cherty silt loam, eroded rolling phase	3
Fullerton silt loam, rolling phase	2
Fullerton silt loam, eroded rolling phase	2
Fullerton cherty silt loam, rolling phase	3
Fullerton cherty silt loam, eroded rolling phase	3
Fullerton loam, rolling phase	2
Fullerton loam, eroded rolling phase	2
Greendale silt loam, rolling phase	2
Greendale cherty silt loam, rolling phase	3
Jefferson loam, eroded rolling phase	3
Jefferson and Montevallo loams, eroded rolling phases	3
Nolichucky gravelly loam, eroded rolling phase	3
Tellico loam, rolling phase	2
Tellico loam, eroded rolling phase	2

[1] Figures denote soil class—Second- and Third-class soils, as described in the section on Use Suitability Groups.

These soils, like those of group 1–G, have light-colored surface soils and are well drained. All except the Jefferson and Montevallo are moderately deep to bedrock. Parts of the Jefferson and Montevallo phases are shallow to bedrock. Soils of this group differ from those of group 1–G chiefly in having a rolling rather than a smooth or undulating surface. The subsoils are firm, but they are permeable to roots and have a fair to good capacity for holding moisture available to plants. A great part of the acreage has been moderately eroded. As a result the surface layer or plow layer ranges in texture from silt loam to silty clay loam. Parts of the Clarksville, Fullerton, and Greendale soils have enough chert to interfere somewhat with cultivation.

Chiefly because of their stronger slope, the soils of this group are quite exacting in management requirements, more so than the soils of group 1–G. They are suited to a wide variety of crops, including corn, small grains, tobacco, and many vegetables; but the row crops cannot well be grown at frequent intervals. Long rotations, heavy fertilization, and supplementary water-control practices generally are required.

Where other management practices are good, productivity can be maintained in a 4- to 6-year rotation that keeps close-growing small grains, hay, or pasture on the soil most of the time. Well suited is a 3-year rotation consisting of corn, a small grain, and then a mixture of clover and orchard grass. Other row crops such as tobacco or potatoes can be used to replace corn, and alfalfa can replace the red

clover after the soil has been brought to a high state of fertility. If it can be done, a cover crop should be sown immediately after the row crop is harvested.

These soils are notably deficient in lime, phosphorus, nitrogen, and organic matter. Most of them probably are also deficient in potash. There is considerable variation in fertility among the members of this group. The Clarksville are notably the least fertile soils, and the less cherty Greendale and Fullerton and the Tellico are among the most fertile. The legume crops, especially the deep-rooted ones, require lime, phosphorus, and potash. If legumes are inoculated, they do not require nitrogen after they have become established. Inoculated legume crops, especially if they predominate in the rotation, will aid greatly in supplying the nitrogen needed for the row crops and small grains. All crops respond well to phosphorus. A complete fertilizer is especially needed for truck crops. Barnyard manure is of great value to crops grown on these soils.

Good tilth is easily maintained. Cultivation ordinarily can be carried on over a fairly wide range of moisture conditions. The chert in some of the soils and the shale in some parts of the Jefferson and Montevallo soils interfere with tillage but in few places prohibit it. Where at all practical, tillage operations should be on the contour. Strip cropping may be feasible on the smoother, longer slopes. Where relatively long rotations are used, terracing is not required. On the deeper soils, especially those of the Clarksville and Fullerton series, terracing may be feasible where it is necessary to grow row crops frequently.

These soils are suited to pasture, but like those of group 1–G, they do not support grazing of high quality unless they are heavily fertilized, especially with lime and phosphorus. Lespedeza and redtop are easily established, but bluegrass, orchard grass, white clover, and the other clovers do not produce well until the soils have been brought to a high state of fertility. Areas that have lain idle for long periods commonly are brushy. The quality of pasture is improved if weeds and excess herbage are mowed.

GROUP 1–I

The soils of group 1–I and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Bolton silty clay loam, severely eroded rolling phase	3
Cumberland silty clay loam, severely eroded rolling phase	3
Decatur silty clay loam, severely eroded rolling phase	3
Dewey silty clay loam, severely eroded rolling phase	3
Fullerton silty clay loam, severely eroded rolling phase	3
Tellico clay loam, severely eroded rolling phase	3
Wolftever silty clay loam, eroded rolling phase	3

[1] Figures denote soil class—Third-class soils, as described in the section on Use Suitability Groups.

All of these soils have relatively heavy plow layers and firm to very firm subsoils. Most of the acreage is very severely eroded. The plow layers now consist largely of firm silty clay loam or silty clay subsoil material. The soils are rolling and moderately deep or deep to bedrock. Except for the Fullerton and Tellico, most of these soils had rather high fertility before they were eroded. Now their produc-

tivity is low. Nevertheless, the physical nature of these soils is such that they will respond fairly well to good management. Under present conditions the infiltration of water is slow and a great part is lost as runoff. The capacity for holding moisture available to plants is low. All of the soils are medium to strongly acid.

These soils require exacting management. Their suitability for crops is limited chiefly to small grains, hay, and pasture crops. If at all feasible, row crops should not be grown. Where they are grown, runoff water develops quickly during rains and is difficult to control. Good management involves chiefly (1) improvement of the physical condition of the soils to increase their ability to absorb and hold moisture available to plants, (2) improvement of tilth conditions, and (3) supplementary means of controlling runoff. One of the more suitable rotations consists of a small grain crop for 1 year, followed by legume hay crop or a legume-grass pasture for 4 or 5 years. A rotation of small grains and lespedeza may be fairly well suited, but under all circumstances these soils should be kept under close-growing vegetation as much as possible.

Adequate fertilization, particularly with phosphorus, lime, and organic matter, are essential to rejuvenate these soils. Deep-rooted legumes such as alfalfa are of special value, as they improve the permeability of the soil and obtain moisture and plant nutrients at a greater depth than most crops. Where there is not enough barnyard manure to meet the needs of these soils, winter cover crops grown to be turned under in spring are of great value. If row crops must be grown, they should always be followed by a winter cover crop.

Tillage of these soils is difficult because of the heavy plow layer, and the range of moisture conditions under which they can be tilled is extremely limited. If the soil is a little to moist, it puddles, and if a little too dry, it breaks into large hard lumps difficult to work into a good seedbed. Large amounts of organic matter will alleviate this condition. Because runoff increases rapidly during rains, tillage should be kept at a minimum and always be done on the contour. Terracing is not practical, but in some places diversion of runoff from higher lying areas may be advisable.

Where these soils are in pasture that is already well established, the chief requirements are periodic application of lime and phosphorus and mowing of weeds and excess herbage. Occasional reseeding may be necessary. Frequent seeding should not be required if fertilization is adequate, grazing is controlled, and weeds are eradicated. Most pastures kept in good condition will improve with age. Where pastures are not established, management is difficult because of unfavorable tilth, slow moisture absorption or droughtiness, and extremely low organic-matter supply. It is usually difficult to get a good plant cover established without risking serious erosion during the process. Lime and phosphorus are necessary in establishing pasture, and supplies of potash may be deficient. Nitrogen is valuable in establishing a good pasture stand. Pasture mixtures should contain drought-resistant plants, and alfalfa or sericea lespedeza are among those preferred. Seeding alfalfa or sericea lespedeza on properly fertilized fields, grazing them after well established, and seeding a pasture mixture in the stubble are considered good management practices.

GROUP 1–J

The soils of group 1–J and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Colbert silty clay loam, eroded undulating phase	3
Sequoia silt loam, undulating phase	2
Sequoia silty clay loam, eroded undulating phase	2
Sequoia-Bland silty clay loams, eroded undulating phases	2
Talbott silty clay loam, eroded undulating phase	2

[1] Figures denote soil class—Second- and Third-class soils, as described in the section on Use Suitability Groups.

These are smooth soils with heavy subsoils and a moderately shallow depth to limestone, calcareous shale, or interbedded limestone and shale bedrock. The surface layers are silt loam or silty clay loam, and the subsoils are silty clay or clay. In most places bedrock is less than 3½ feet from the surface, and some areas have a few rock outcrops. The natural fertility is moderate, and the reaction medium to strongly acid. The subsoils are slowly permeable to water. The capacity for holding moisture available to plants is notably less than for soils of groups 1–A to 1–D, inclusive.

The suitability for crops is wide, although the more friable permeable soils such as those of Groups 1–A and 1–C are much preferred for truck crops, especially root crops. Small grains, hay, and pasture crops are among those best suited. Management requirements are not especially exacting, but limited fertility, somewhat restricted moisture supply, slow permeability, and consequent erosion hazard make proper management more complex than for the soils of several other groups.

Rotations lasting 3 to 4 years are feasible if effective methods of restraining erosion are used. A sequence of either (1) corn, a small grain, and red clover or (2) corn, a small grain, and alfalfa for 3 or 4 years is well suited. A cover crop following the row crop is an important part of the rotation, as it aids in maintaining fertility and protects the soil from erosion during winter when it otherwise would be bare. On the more sloping parts it may be necessary to do field work on the contour. Generally, however, such supplemental means of controlling runoff are not a major requirement on these soils if their fertility is kept high and growing of row crops is restricted.

Fertilization and liming are of great importance in keeping these soils productive. Legumes and grasses especially need lime and phosphorus, and potash may contribute much to their productivity. Nitrogen is a general requirement, but legumes may supply a good part of it when they make up much of the rotation.

Tilth of these soils is only fair. Their plow layers are rather heavy and cannot be worked under a wide range of moisture conditions. Addition of organic matter and use of sod crops and deep-rooted legumes aid in improving and maintaining favorable tilth. Fall plowing, which allows freezing and thawing of the plow layer, helps maintain good tilth if erosion losses can be avoided during the time the soil is without a vegetative cover.

These soils are well suited to pasture, although the restricted moisture supply greatly reduces grazing during the drier periods. The

better legumes and grasses are not difficult to establish if soil fertility is kept fairly high. Lime and phosphorus are chiefly needed, but nitrogen may aid greatly in getting a good stand of pasture started. Pastures on the more eroded patches are greatly improved by adding substantial amounts of barnyard manure. Weeds, brush, and excess herbage should be mowed or clipped to maintain a good pasture stand.

GROUP 1-K

The soils of group 1–K and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Bland silt loam, rolling phase	3
Bland silty clay loam, eroded rolling phase	3
Colbert silty clay loam, eroded rolling phase	3
Sequoia silt loam, rolling phase	2
Sequoia silty clay loam, eroded rolling phase	3
Sequoia-Bland silty clay loams, eroded rolling phases	3
Talbott silty clay loam, eroded rolling phase	2

[1] Figures denote soil class—Second- and Third-class soils, as described in the section on Use Suitability Groups.

The soils of this group differ from those of group 1–J chiefly in having a more sloping surface, the gradient ranging from 5 to 12 percent. All have silt loam or silty clay loam surface soil, firm silty clay or clay subsoil, and bedrock of limestone, calcareous shale, or interbedded limestone and shale at a depth of about 3 feet. The natural fertility is moderate, and the reaction is medium to strongly acid. The subsoils are slowly permeable to water, and the capacity for holding moisture available to plants is rather low.

Almost all of the commonly grown general farm crops, including small grains, corn, hay, and pasture, are suitable. Production of truck crops and tobacco is not practical, however, because of the less favorable tilth and limited supply of moisture. Required are moderately long rotations in which the close-growing small grains and hay and pasture crops predominate. A rotation of corn, a small grain, and alfalfa for 3 or 4 years is considered suitable. When a row crop is grown, particular care is required to check erosion, as runoff develops quickly during rains.

Regular fertilization is necessary if moderately high yields are to be obtained, as the content of plant nutrients and organic matter has been notably depleted by erosion. Phosphorus, lime, and organic matter are the chief fertilizer requirements for a rotation of general farm crops in which legumes are an important part. Nitrogen is needed for the corn crop and it is of value in getting a hay crop established. Boron is required for alfalfa. It is especially important that a winter cover crop follow the row crop, as areas left bare of vegetation erode during winter.

The clayey plow layer makes the tilth of much of this group only fair. Tillage can be carried on in a narrow moisture range. The soil puddles easily when too wet, and is difficult to till and breaks into large clods when dry. When at all feasible, field operations should be done on the contour and strip cropping used to restrain the erosive

action of runoff. It is unlikely that terracing is practical on such heavy soils, especially since bedrock is at a rather shallow depth.

If there is enough acreage on the farm of soils better suited to crops requiring cultivation, a large part of the soils of this group can well be used for pasture for extended periods. If fertility is brought to a fairly high level, especially in phosphorus and lime, pasture of the more desirable legumes and grasses can be maintained. It may be difficult to establish a stand on the more eroded parts, however, because moisture conditions are unfavorable and the supply of plant nutrients is limited. Substantial applications of barnyard manure are of particular value in helping pasture vegetation get a start. Even under the most favorable circumstances, pasture growth on these soils is greatly hampered by droughtiness. During the drier periods it will be necessary to avoid overgrazing so as to prevent a reduced stand and consequent erosion. Pastures are improved by mowing or clipping weeds and excess herbage.

GROUP 1–L

The soils of group 1–L and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Montevallo shaly silt loam, eroded undulating phase	3
Sequoia silty clay loam, severely eroded undulating phase	3

[1] Figures denote soil class—Third-class soils, as described in the section on Use Suitability Groups.

This group includes smooth or undulating soils that are very shallow to shale bedrock. They are low in fertility and have a low capacity for holding moisture available to plants. Their reaction is medium to strongly acid. The Sequoia soil has a heavy plow layer, and the Montevallo a shaly one.

The suitability for crops is narrow, and management requirements for maintaining fair fertility and moisture supply are exacting. Among the better rotations are moderately long to long ones consisting chiefly of small grains and hay and pasture crops. Corn and soybeans are suited. High value crops such as tobacco and vegetables are not, since the low moisture supply of these soils limits yields, and the tilth of most of the acreage is unfavorable.

Substantial quantities of organic matter are of value to these soils for improving their tilth, moisture-holding capacity, and fertility. Phosphorus, nitrogen, and lime are the chief fertilizer requirements and heavy applications are necessary for maintaining good yields.

Chiefly because these soils are limited in ability to produce crops, a great part of the acreage probably can be used best as pasture. Their small capacity for holding moisture available to plants limits their productivity for pasture. Lespedeza and redtop are among the more easily established pasture plants; but where lime, phosphorus, and some nitrogen are applied, a satisfactory stand of the more desirable legumes and grasses can be obtained. A heavy application of barnyard manure is of great value in getting a good pasture stand established, but maintenance afterwards requires periodic applications only of phosphorus and lime.

GROUP 1–M

The soils of group 1–M and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Bolton silt loam, eroded hilly phase	3
Cumberland silty clay loam, eroded hilly phase	3
Decatur silty clay loam, eroded hilly phase	3
Dewey silty clay loam, eroded hilly phase	3
Etowah silty clay loam, eroded hilly phase	3

[1] Figures denote soil class—Third-class soils, as described in the section on Use Suitability Groups.

These are hilly red soils of the limestone valleys and high stream terraces. They are at least moderately fertile and are well drained and deep to bedrock. A great part of their acreage has been so eroded that the plow layer is now a mixture of the original surface soil and subsoil material. The plow layer is silty clay loam in most places, and the subsoil is firm silty clay that somewhat retards percolation of water but is easily penetrated by roots. The soils are medium to strongly acid. Part of the Cumberland soil has gravel or cobbles sufficient to interfere materially with cultivation.

The soils of group 1–M are suited to general farm crops, chiefly corn, small grains, and hay and pasture. They are also suited to tobacco and vegetables, but their strong slope and shallow depth to the firm subsoil make them less favorable for these crops than soils of several of the other groups. Good stands of the more exacting grasses and legumes are relatively easily maintained. Long rotations are needed to conserve these soils and increase their suitability range. Under normal conditions rotations consisting predominantly of small grains and hay and pasture crops are well suited. A row crop can be included in the rotation about once in 5 or 6 years. Unless a winter cover crop immediately follows the row crops, a notable amount of erosion will result during the following winter.

Crops usually respond to moderate to heavy fertilization. Phosphorus and lime are among the chief requirements. If adequate barnyard manure is not available, legume crops turned under every few years will aid in maintaining the organic matter.

If good tilth is to be maintained, these soils should be tilled only under favorable moisture conditions. Puddling will result if the soils are cultivated when moist, and clodding if cultivated when dry. Field work done on the contour aids greatly in restraining runoff. Where at all feasible, this practice should be diligently followed. Slopes are too steep and subsoils too heavy to make terracing of these soils practical, but strip cropping of the smoother slopes is a practical way of diminishing erosion hazard. Some farmers practice subsoiling to increase the rate of infiltration of water. In a few cases this method has partly displaced plowing.

Pasture is a suitable use for these soils, considering how difficult it is to keep them productive for crops requiring tillage. When moderately fertilized, particularly with phosphorus and lime, good stands of the more desirable legumes and grasses can be maintained. Their shallow depth and clayey subsoil limit the capacity for holding moisture available to plants. In consequence, the productivity of pasture is lowered during drier parts of the grazing season, particularly on the south-facing slopes. On the more eroded parts, substan-

tial applications of barnyard manure will help in establishing a good stand of desirable pasture plants. After a good pasture has been established, periodic applications of phosphorus and lime will maintain productivity.

GROUP 1–N

The soils of group 1–N and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Fullerton silt loam, hilly phase	3
Fullerton silt loam, eroded hilly phase	3
Fullerton loam, hilly phase	3
Fullerton loam, eroded hilly phase	3
Tellico loam, hilly phase	3
Tellico loam, eroded hilly phase	3
Waynesboro loam, eroded hilly phase	3

[1] Figures denote soil class—Third-class soils, as described in the section on Use Suitability Groups.

The soils of this group are similar to those of group 1–M in that they are hilly and relatively deep to bedrock. They differ in having a lighter color, lower fertility, and slightly greater permeability. The Fullerton soils are in the cherty ridge section, and the Tellico soils in the Tellico-Neubert soil association. The Waynesboro soil is on high stream terraces. All are moderate to low in fertility and medium to strongly acid, and all have a fair capacity for holding moisture available to plants. The surface layers are predominantly loam or silt loam. The subsoils are firm enough to retard infiltration somewhat. The Tellico and Waynesboro soils are more permeable than the Fullerton. A small part of the Waynesboro soil contains gravel or cobblestones in numbers sufficient to interfere materially with cultivation.

Chiefly because of the strong slope, the suitability of these soils is limited. Production of crops that require frequent cultivation and a large amount of labor is impractical. Long rotations consisting chiefly of small grains and legume and grass hay and pasture crops are well suited. Row crops should not be grown more often than once in 5 or 6 years, and they should always be followed by a winter cover of close-growing vegetation that will protect the soil. The more desirable legumes and grasses—white clover, alfalfa, red clover, bluegrass, and orchard grass—are more difficult to establish and maintain than on the more fertile soils. Fairly good stands can be obtained if adequate fertilization has been practiced. Phosphorus, lime, and organic matter, are especially needed.

All of these soils will require regular applications of fertilizer to keep up their productivity. The row crops will need complete fertilization with nitrogen, phosphorus, and potash. The legume and grass hay crops will need phosphorus, potash, and lime.

Good tilth is fairly easy to maintain except on the more eroded patches, where care must be taken not to till the soil when it is excessively wet or dry. All field operations should be done on the contour. On the longer smoother slopes, strip cropping is a practical means of restraining runoff. These soils are too steep for terracing, but it may be practical and advisable to divert runoff from some higher lying areas. Subsoiling is practiced by some farmers to improve permeability.

Pasture is well suited, as it effectively controls runoff and a minimum of work is required to maintain its productivity. Lespedeza and redtop are among the more easily established pasture plants; but where the fertility has been brought to a high level, the more exacting legumes and grasses afford fair grazing. Much of their acreage, especially on the more southerly exposures, becomes too dry for good plant growth during parts of the grazing season. Weedy and brushy growth, especially on areas that have been lying idle, lower the quality and grazing capacity. It is practical to reduce this type of vegetation by mowing or clipping.

GROUP 2–A

The soils of group 2–A and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Colbert silty clay, severely eroded rolling phase	4
Fullerton cherty silty clay loam, severely eroded rolling phase	4
Jefferson and Montevallo clay loams, severely eroded rolling phases	4
Montevallo shaly silt loam, eroded rolling phase	4
Sequoia silty clay loam, severely eroded rolling phase	4
Sequoia-Bland silty clay loams, severely eroded rolling phases	4
Stony rolling land, Colbert and Talbott soil materials	4
Talbott silty clay loam, severely eroded rolling phase	4

[1] Figures denote soil class—Fourth-class soils, as described in the section on Use Suitability Groups.

This group of soils has a rolling surface and shallow depth to clayey subsoil material, to bedrock, or to both. The shallow depth and generally clayey texture make them poorly suited to crops requiring tillage. Practically all of them except the stony land types have lost a great part of their original surface soil, and as a result the plow layer consists of clayey subsoil material. The Montevallo soil, though less clayey, has a high content of shale. The fertility of these soils is low. They are normally medium to strongly acid, although the Colbert soil may be slightly acid in places. The ability to absorb water is very limited, and the capacity for holding moisture available to plants is small. Practically all of the acreage is therefore droughty and incapable of supporting good plant growth during the drier parts of the growing season.

Because of their unfavorable characteristics, use of these soils is limited chiefly to pasture or forest. Areas that must be used for crops will require extremely exacting management if they are to be built up in fertility, improved in tilth, and protected against erosion. The better suited crops are small grains and certain hay crops. Except for some areas of Stony rolling land, Colbert and Talbott soil materials, most of the acreage normally is not productive of pasture.

By incorporating organic matter in these soils and increasing their content of lime and phosphorus, fairly good stands of suitable pasture plants can be established. The more severely eroded areas are best developed for grazing by establishing a cover of kudzu. Even so, several years normally will be required. Further development of the numerous small gullies should be stopped. Diversion of runoff water from adjoining higher slopes may help. On the higher lying areas of these soils grazing will be limited to the moister parts of the growing season, even under the most favorable conditions. At

least this will be true until the tilth and permeability of the soils have been improved.

GROUP 2–B

The soils of group 2–B and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Bolton silty clay loam, severely eroded hilly phase	4
Bolton silt loam, eroded steep phase	4
Bolton silty clay loam, severely eroded steep phase	4
Cumberland silty clay loam, severely eroded hilly phase	4
Decatur silty clay loam, severely eroded hilly phase	4
Dewey silty clay loam, severely eroded hilly phase	4
Dewey silty clay loam, eroded steep phase	4
Etowah silty clay loam, severely eroded hilly phase	4
Tellico clay loam, severely eroded hilly phase	4
Waynesboro clay loam, severely eroded hilly phase	4

[1] Figures denote soil class—Fourth-class soils, as described in the section on Use Suitability Groups.

This group consists of severely eroded hilly and steep red soils. Most of the original surface soil has been lost through erosion. The surface layers or plow layers now consist largely of reddish firm silty clay loam or silty clay subsoil material. The slope ranges from 12 to 50 percent. The natural fertility is moderate except on the less eroded parts, where it is moderately high. The reaction is medium to strongly acid. Moisture infiltrates slowly, and runoff develops quickly during rains. The capacity for holding moisture available to plants is small. The soils are droughty. The soil material, however, is permeable to roots and the depth to bedrock is more than 5 feet in most places.

The soils of this group are poorly suited to crops requiring tillage because of poor tilth, strong slope, slow permeability, and droughtiness. They are suitable for pasture but their carrying capacity is limited by the rather small quantity of moisture held for plants. If at all feasible, areas that must be used for crops should be managed in an exceptionally long rotation consisting entirely of close-growing crops.

Where these soils already support good pasture, it can be maintained chiefly by applying lime and phosphorus periodically and by mowing or clipping weeds and other excess herbage. Occasional reseeding may be necessary, but ordinarily it is not needed if fertilization is adequate, grazing is properly controlled, and weeds are systematically eradicated. If these management practices are used the pastures can be expected to improve with age.

Unfavorable tilth, tendency to clod and bake, slow absorption of moisture, and extreme deficiency in organic matter make establishment of new pastures difficult on these soils. Treatment with lime and phosphorus is a necessary part of initial fertilization. Potash may also be necessary, and applications of nitrogen may aid in getting desirable vegetation started. If organic manure is available, a substantial application will aid greatly in this initial stage. The pasture mixture seeded should contain a considerable portion of drought-resistant plants. The seeding of alfalfa or sericea lespedeza on a well-prepared seedbed is considered a good practice. Following a period of grazing, seeding with a pasture mixture of mixed legumes and grasses may improve the grazing capacity.

GROUP 2–C

The soils of group 2–C and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Armuchee silty clay loam, eroded hilly phase	4
Armuchee silt loam, steep phase	4
Armuchee silty clay loam, eroded steep phase	5
Bland silty clay loam, eroded hilly phase	4
Colbert silty clay, severely eroded hilly phase	4
Dandridge shaly silt loam, eroded hilly phase	4
Dandridge silt loam, steep phase	4
Dandridge shaly silt loam, eroded steep phase	4
Dandridge and Litz silt loams, hilly phases	4
Dandridge and Litz shaly silt loams, eroded hilly phases	4
Dandridge and Litz silt loams, steep phases	4
Farragut silty clay loam, eroded hilly phase	4
Sequoia-Bland silty clay loams, eroded hilly phases	4
Sequoia-Bland silty clay loams, severely eroded hilly phases	4
Stony hilly and steep land Colbert and Talbott soil materials	4
Talbott silty clay loam, severely eroded hilly phase	4

[1] Figures denote soil class—Fourth- and Fifth-class soils, as described in the section on Use Suitability Groups.

All of these soils are shallow to bedrock and have silt loam, silty clay loam, or silty clay surface layers. Practically all of them are underlain by calcareous rock, including limestone, calcareous shale, and interbedded limestone and shale. They are moderate to fairly high in fertility and medium acid to alkaline. They have relatively slow permeability; consequently, runoff quickly develops on much of the acreage during rains. The capacity for holding moisture available for crops is small, and the thickness of soil material in which roots can develop is not great. Many of these soils have occasional rock outcrops, and the stony land type has enough to prohibit practical tillage.

These soils are not suitable for crops requiring tillage. Nevertheless, if the need is pressing, there are areas that can be used for crops with a fair success if careful management is practiced. Areas used for tilled crops require extremely exacting management if they are to be conserved against excessive erosion.

All of the soils of this group are capable of maintaining a fair to very good stand of the more desirable pasture plants, including bluegrass, white clover, and orchard grass; but a great part will require fertilization, especially with phosphorus. Most areas of the Dandridge and Armuchee soils will not require lime, but the Farragut, Sequoia, Bland, and Talbott soils and much of the stony land type will respond to lime as well as phosphorus. Potash will improve the productivity of these soils for pasture plants. A good practice is to seed alfalfa or sericea lespedeza on properly fertilized areas, graze the pasture after it is well established, and then seed a pasture mixture in the stubble. Applications of barnyard manure are of especial value in getting a good pasture cover established on the more eroded parts. Grazing vegetation will be improved if weeds, brushy growth, and excess herbage are suppressed by mowing.

GROUP 2–D

The soils of group 2–D and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Clarksville cherty silt loam, hilly phase	4
Clarksville cherty silty loam, eroded hilly phase	4
Fullerton silty clay loam, severely eroded hilly phase	4
Fullerton cherty silt loam, hilly phase	4
Fullerton cherty silt loam, eroded hilly phase	4
Fullerton cherty silty clay loam, severely eroded hilly phase	4

[1] Figures denote soil class—Fourth-class soils, as described in the section on Use Suitability Groups.

The soils of this group are deep to bedrock. All are hilly, low in fertility, medium to strongly acid, and predominantly cherty. On the average they are more permeable to moisture than the soils of groups 2–A, 2–B, and 2–C, but the more exposed parts have a rather limited capacity for holding moisture available to plants and are droughty during drier parts of the growing season.

These soils are poorly suited to crops, chiefly because of their strong slope and rather low fertility. They are capable of producing a fair amount of pasture where properly fertilized and seeded. The more desirable legumes, however, are more difficult to establish and maintain on these soils than on some of the more fertile soils. Lespedeza and redtop are therefore better suited pasture plants where the fertility has not been brought to a high level.

If good pastures are to be established and maintained, substantial applications of lime and phosphorus are necessary. Heavy applications of barnyard manure, if available, will aid greatly in establishing a good stand. Where manure is not available, applications of nitrogen will aid materially. Because of the strong slope and low fertility, it is difficult to get a good stand of pasture plants before erosion removes much of the soil material. Where the fertility has been brought to a high level, a pasture cover consisting of the more desirable legumes and grasses may be practical. Since the quality of pasture may deteriorate after a period of years, cultivation for 1 year will reduce weedy growth. Periodic mowing of weeds and excess herbage will also aid in maintaining the quality of the pasture.

GROUP 2–E

The soils of group 2–E and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Guthrie silt loam	4
Melvin silt loam	4
Prader silt loam	4
Tyler silt loam	4

[1] Figures denote soil class—Fourth-class soils, as described in the section on Use Suitability Groups.

This group includes the poorly drained soils. In general both their surface soils and subsoils are gray, low in fertility, and medium to strongly acid. The surface soils in most places are silt loam with fairly good tilth, but the subsoils are silty clay loam, silty clay, or clay that is firm and rather compact. Both internal drainage and surface runoff are very slow. During winter the water table is at or near the

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surface; but during the driest part of the year, a large part of the acreage is extremely dry and moisture relations, or the capacity to hold moisture available to crops, is not great.

Under natural conditions these soils are poorly suited to crops requiring tillage. They are suitable for pasture, although desirable pasture vegetation is not common to them. Grazing vegetation can be improved by proper fertilization, but most areas will require at least enough artificial drainage to remove excess moisture during the wetter parts of the growing season. Such drainage can be accomplished in many places by digging ditches. When an adequate surface drainage system has been installed and moderately heavy applications of lime are applied, fairly good grazing can be produced by seeding bluegrass, white clover, redtop, and lespedeza. After the soil has had organic matter added for a number of years, its moisture-holding capacity in the drier seasons will improve, and its productivity of pasture will be better during most of the growing season.

Some areas of these soils can be sufficiently drained by tile to make them suitable for crops requiring tillage. The compaction of the subsoil and the availability of an adequate drainage outlet are important in determining the feasability of installing tile. Adequately drained areas can produce such crops as corn, soybeans, certain legumes, and grass and hay crops, but they will require heavy fertilization. Where drainage has been installed and fertility has been increased and maintained, the soils of this group are suitable for intensive use for row crops and for the production of certain truck crops.

GROUP 3–A

The soils of group 3–A and their use suitability group are as follows:

Soils:	*Use suitability group* [1]
Bland silt loam, steep phase	5
Bland silty clay loam, eroded steep phase	5
Clarksville cherty silt loam, steep phase	5
Clarksville cherty silt loam, eroded steep phase	5
Dandridge and Litz shaly silt loams, eroded steep phases	5
Fullerton cherty silt loam, steep phase	5
Fullerton cherty silt loam, eroded steep phase	5
Fullerton cherty silty clay loam, severely eroded steep phase	5
Gullied land, Armuchee and Litz soil materials	5
Gullied land, Fullerton and Talbott soil materials	5
Gullied land, Sequoia and Montevallo soil materials	5
Gullied land, Talbott and Decatur soil materials	5
Gullied land, Tellico and Muskingum soil materials	5
Limestone rockland, rolling and hilly	5
Limestone rockland, steep	5
Made land	5
Montevallo silt loam, steep phase	5
Montevallo shaly silt loam, eroded steep phase	5
Montevallo shaly silt loam, eroded hilly phase	5
Muskingum stony fine sandy loam, steep phase	5
Muskingum-Lehew fine sandy loams, steep phases	5
Muskingum-Lehew fine sandy loams, eroded steep phases	5
Muskingum-Lehew fine sandy loams, hilly phases	5
Muskingum-Lehew fine sandy loams, eroded hilly phases	5
Stony very steep land, Muskingum soil material	5
Tellico loam, steep phase	5
Tellico loam, eroded steep phase	5
Tellico clay loam, severely eroded steep phase	5

[1] Figures denote soil class—Fifth-class soils as described in the section on Use Suitability Groups.

All of the soils of this group have one or more characteristics that make them poorly suited to crops and pasture. They are low or very low in fertility and have unfavorable moisture relations. A great many have steep slopes; some are severely eroded or gullied; and some are very shallow to bedrock. Their suitability is limited to forest. Where the need is great, small areas may be used with some success for pasture or occasional crops, provided they are carefully managed. All areas to be cropped or pastured will require substantial fertilization and should be tilled as little as possible. The strong slope of most areas makes the distribution of fertilizer and lime very difficult, even on the more accessible parts.

Close-growing vegetation should be maintained as much as possible, and field operations should be according to the contour. In places strip cropping will aid in controlling erosion if tilled crops must be grown.

A large part of these soils is now in forest, and most of the remaining acreage should be reforested. A suitable forest cover will establish itself in most places if it is adequately protected against fire and grazing. In some places, planting will be necessary, and shortleaf pine is one of the better trees for this purpose.

The management practices for the production of forest can be grouped as follows: (1) establishment and maintenance of a full stand of desirable trees, (2) systematic cutting and weeding of trees, (3) harvesting of mature trees in such a manner that desirable trees will succeed them, and (4) the control, as far as possible, of fires, browsing, trampling, and other damage. Practices in the first three groups are those of forest management, whereas those of the last group pertain to both soil and forest management.

EXPECTABLE AVERAGE YIELDS

Average yields that can be expected over a period of years for the soils of Knox County under two levels of management are shown in table 4. Comparison can thus be made of yields on different soils under the same level of management and of crop responses under good and under common management.

The yields given in columns A are those expected under the prevailing, or most common, practices of soil management. These practices are not the same for all soils or for any given soil in different parts of the county or on different farms, but the current practices given in the section on Soil Types and Phases in the individual soil descriptions are representative. 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 tables for other counties in Tennessee having similar soils. Specific crop-yield records by soil types are not generally available, but the summation of local experience will give fairly reliable predictions of the yields that may be expected under management commonly practiced.

TABLE 4.—*Average yields of crops that may be expected over a period of years under two levels of management on the soils of Knox County, Tenn.*

[Estimated yields in columns A are those to be expected under common practices of management; estimated yields in columns B are those to be expected under good practices of management; where no data are given, either the crop is not grown under the specified condition or the soil is not suited.]

Soil	Map symbol	Corn		Wheat		Oats		Lespedeza		Alfalfa		Tobacco		Pasture	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Lb.*	*Lb.*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Alcoa silt loam:															
Eroded undulating phase	AB	30	55	15	25	33	55	1.1	1.7	3.1	3.8	1,400	1,900	90	135
Eroded rolling phase	AA	28	53	14	24	35	55	1.0	1.6	2.6	3.2	1,300	1,800	80	120
Armuchee silty clay loam, eroded hilly phase	AD	18	28	8	17	16	28	.8	1.4	2.0	2.5	700	1,200	50	85
Armuchee silt loam, steep phase	AC	----	----	----	----	----	----	----	----	----	----	----	----	45	70
Armuchee silty clay loam, eroded steep phase	AE	----	----	----	----	----	----	----	----	----	----	----	----	20	40
Bland silt loam, rolling phase	BA	22	30	11	20	23	36	.7	1.2	2.1	2.6	800	1,200	50	85
Bland silty clay loam:															
Eroded rolling phase	BD	20	28	10	18	16	32	.7	1.2	2.0	2.5	700	1,100	40	75
Eroded hilly phase	BC	16	25	7	16	14	28	.6	1.1	1.9	2.4	----	----	40	70
Bland silt loam, steep phase	BB	----	----	----	----	----	----	----	----	----	----	----	----	30	60
Bland silty clay loam, eroded steep phase	BE	----	----	----	----	----	----	----	----	----	----	----	----	25	50
Bolton silt loam, eroded hilly phase	BF	25	40	11	20	22	40	.8	1.5	2.3	2.8	1,000	1,500	65	100
Bolton silty clay loam, severely eroded hilly phase	BK	----	----	----	----	----	----	----	----	1.2	2.0	----	----	35	70
Bolton silt loam, eroded steep phase	BH	----	----	----	----	----	----	----	----	----	----	----	----	55	90
Bolton silty clay loam, severely eroded steep phase	BM	----	----	----	----	----	----	----	----	----	----	----	----	35	70
Bolton silt loam, eroded rolling phase	BG	25	50	12	22	27	45	.9	1.8	2.4	3.0	1,200	1,700	70	110

Bolton silty clay loam, severely eroded rolling phase	BL	13	30	5	11	13	25	.4	1.0	1.2	2.0	----	----	40	75
Camp silt loam	CA	30	55	14	23	35	55	1.2	1.9	2.5	3.2	1,000	1,400	90	145
Chewacla silt loam	CB	38	60	----	----	----	----	1.4	1.9	----	----	----	----	90	125
Clarksville cherty silt loam:															
Rolling phase	CG	15	40	8	17	20	35	.5	1.4	----	----	800	1,400	30	65
Eroded rolling phase	CD	15	38	7	16	18	33	.5	1.4	----	----	700	1,300	30	65
Hilly phase	CF	12	32	7	16	18	32	.4	1.3	----	----	700	1,300	27	60
Eroded hilly phase	CC	12	30	6	15	15	28	.4	1.3	----	----	700	1,200	25	60
Steep phase	CH	----	----	----	----	----	----	----	----	----	----	----	----	22	50
Eroded steep phase	CE	----	----	----	----	----	----	----	----	----	----	----	----	20	50
Colbert silty clay loam:															
Eroded undulating phase	CN	18	35	12	19	24	35	.7	1.3	2.5	2.9	700	1,100	50	90
Eroded rolling phase	CM	15	30	10	17	20	35	.6	1.2	2.2	2.8	----	----	40	80
Colbert silty clay:															
Severely eroded rolling phase	CL	----	20	4	8	8	16	----	1.0	----	----	----	----	30	55
Severely eroded hilly phase	CK	----	----	----	----	----	----	----	----	----	----	----	----	25	45
Congaree fine sandy loam	CO	40	60	14	19	30	45	1.3	1.8	3.0	3.6	1,400	1,800	80	115
Low-bottom phase	CP	42	62	13	17	----	----	1.5	1.9	----	----	----	----	80	115
Congaree silt loam	CR	45	65	15	20	35	50	1.6	2.0	3.2	3.8	1,500	1,900	115	145
Low-bottom phase	CS	52	70	14	18	----	----	1.6	2.0	----	----	----	----	115	145
Cumberland silty clay loam:															
Eroded undulating phase	CW	33	57	17	27	38	60	1.1	1.7	3.0	3.8	1,500	2,000	90	130
Eroded rolling phase	CV	30	55	16	26	34	55	1.0	1.6	2.7	3.3	1,400	1,800	80	120
Severely eroded rolling phase	CY	13	30	7	14	15	33	.5	1.1	1.4	2.2	----	----	45	85
Eroded hilly phase	CU	25	40	12	22	25	42	1.0	1.6	2.5	3.1	1,000	1,500	75	105
Severely eroded hilly phase	CX	----	----	----	----	----	----	----	----	1.3	2.1	----	----	40	75
Cumberland gravelly fine sandy loam, eroded rolling phase	CT	23	48	11	20	25	42	.9	1.5	2.3	3.1	1,200	1,600	70	105
Dandridge shaly silt loam, eroded hilly phase	DE	18	28	8	17	16	28	.8	1.4	2.0	2.5	----	----	50	85
Dandridge silt loam, steep phase	DG	----	----	----	----	----	----	----	----	----	----	----	----	45	70
Dandridge shaly silt loam, eroded steep phase	DF	----	----	----	----	----	----	----	----	----	----	----	----	40	60
Dandridge and Litz silt loams, hilly phases	DC	22	30	9	17	18	30	.8	1.4	2.0	2.6	----	----	50	85
Dandridge and Litz shaly silt loams, eroded hilly phases	DA	18	28	8	17	16	28	.7	1.3	1.9	2.4	----	----	45	80

See footnotes at end of table.

TABLE 4.—*Average yields of crops that may be expected over a period of years under two levels of management on the soils of Knox County, Tenn.*—Continued

Soil	Map symbol	Corn		Wheat		Oats		Lespedeza		Alfalfa		Tobacco		Pasture	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Lb.*	*Lb.*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Dandridge and Litz silt loams, steep phases	DD	----	----	----	----	----	----	----	----	----	----	----	----	40	65
Dandridge and Litz shaly silt loams, eroded steep phases	DB	----	----	----	----	----	----	----	----	----	----	----	----	30	50
Decatur silt loam, undulating phase	DK	40	62	18	28	40	65	1.4	2.0	3.2	4.0	1,600	2,100	95	140
Decatur silty clay loam, eroded undulating phase	DN	35	57	17	27	38	60	1.2	1.8	3.0	3.8	1,500	2,000	90	130
Decatur silt loam, rolling phase	DH	35	57	17	27	37	60	1.3	1.8	3.0	3.8	1,500	2,000	90	125
Decatur silty clay loam:															
Eroded rolling phase	DM	32	55	16	26	34	55	1.1	1.7	2.8	3.4	1,400	1,900	80	125
Severely eroded rolling phase	DP	13	30	7	14	15	33	.5	1.1	1.5	2.3	----	----	45	85
Eroded hilly phase	DL	27	45	14	24	28	45	1.0	1.6	2.6	3.2	1,100	1,600	80	110
Severely eroded hilly phase	DO	----	----	----	----	----	----	----	----	1.4	2.2	----	----	40	75
Dewey silt loam, undulating phase	DS	35	60	16	26	37	60	1.3	1.9	3.1	3.8	1,500	2,000	90	135
Dewey silty clay loam, eroded undulating phase	DW	30	55	15	25	33	55	1.1	1.7	2.9	3.6	1.400	1,900	85	125
Dewey silt loam, rolling phase	DR	30	55	15	25	35	55	1.2	1.7	2.9	3.6	1,400	1,900	85	125
Dewey silty clay loam:															
Eroded rolling phase	DU	28	53	14	24	30	50	1.0	1.6	2.7	3.3	1,300	1,800	80	120
Severely eroded rolling phase	DY	13	30	6	12	14	26	.5	1.1	1.3	2.1	----	----	45	80
Eroded hilly phase	DT	25	40	12	22	25	42	.9	1.5	2.4	3.0	1,100	1,600	75	105
Severely eroded hilly phase	DX	----	----	----	----	----	----	----	----	1.2	2.0	----	----	40	75
Eroded steep phase	DV	----	----	----	----	----	----	----	----	----	----	----	----	65	100

Emory silt loam:															
Undulating phase	Ec	50	70	18	28	40	60	1.5	2.0	3.0	3.7	1,800	2,200	130	155
Rolling phase	Eb	47	65	17	26	37	57	1.4	2.0	2.8	3.5	1,700	2,100	125	150
Emory and Abernathy silt loams	Ea	45	65	15	20	35	55	1.5	2.0	3.3	4.0	1,500	2,000	120	150
Etowah silt loam, undulating phase	Ed	35	60	16	26	37	60	1.3	1.9	3.1	3.8	1,500	2,000	90	135
Etowah silty clay loam:															
Eroded undulating phase	Eg	30	55	15	25	33	55	1.1	1.7	3.0	3.6	1,400	1,900	85	125
Eroded rolling phase	Ef	28	53	14	24	30	50	1.0	1.6	2.7	3.3	1,300	1,800	80	120
Eroded hilly phase	Ee	24	38	11	21	24	40	.9	1.4	2.3	2.8	1,100	1,600	75	105
Severely eroded hilly phase	Eh	12	30	----	----	----	----	----	----	1.1	2.0	----	----	40	75
Farragut silty clay loam:															
Eroded undulating phase	Fc	33	55	17	27	35	55	1.1	1.7	2.9	3.4	1,400	1,900	85	125
Eroded rolling phase	Fb	28	53	14	24	30	50	1.0	1.6	2.6	3.2	1,300	1,800	75	110
Eroded hilly phase	Fa	25	38	12	21	25	42	.9	1.5	2.4	3.0	1,100	1,600	70	100
Fullerton silt loam:															
Undulating phase	Fx	27	52	13	22	30	46	1.0	1.8	2.4	3.1	1,200	1,600	70	125
Eroded undulating phase	Fu	25	50	12	21	28	43	.9	1.6	2.3	2.8	1,100	1,500	65	115
Rolling phase	Fw	25	48	12	21	28	43	.9	1.6	2.2	2.9	1,100	1,500	60	110
Eroded rolling phase	Ft	23	45	11	20	25	40	.8	1.5	2.1	2.6	1,000	1,400	55	105
Fullerton silty clay loam, severely eroded rolling phase	Fz	10	28	5	10	12	25	.4	1.0	1.2	1.9	----	----	35	70
Fullerton silt loam:															
Hilly phase	Fv	22	38	10	18	25	38	.8	1.5	2.0	2.7	900	1,400	50	95
Eroded hilly phase	Fs	20	35	9	18	20	35	.7	1.4	1.9	2.4	800	1,300	45	90
Fullerton silty clay loam, severely eroded hilly phase	Fy	----	----	----	----	----	----	.5	----	1.1	1.7	----	----	30	60
Fullerton cherty silt loam:															
Rolling phase	Fh	23	45	10	20	25	40	.8	1.5	2.0	2.7	1,000	1,400	55	100
Eroded rolling phase	Fe	20	42	10	20	23	38	.7	1.4	1.9	2.4	900	1,300	50	95
Fullerton cherty silty clay loam, severely eroded rolling phase	Fk	8	25	5	10	10	22	.3	.8	1.1	1.8	----	----	35	65
Fullerton cherty silt loam:															
Hilly phase	Fg	20	35	9	17	22	35	.7	1.4	1.8	2.5	800	1,300	45	90
Eroded hilly phase	Fd	18	35	8	16	18	30	.6	1.3	1.7	2.2	700	1,200	40	85
Fullerton cherty silty clay loam, severely eroded hilly phase	Fj	----	----	----	----	----	----	.3	.7	----	----	----	----	25	55
Fullerton cherty silt loam:															
Steep phase	Fi	----	----	----	----	----	----	----	----	----	----	----	----	40	75
Eroded steep phase	Ff	----	----	----	----	----	----	----	----	----	----	----	----	35	70

See footnotes at end of table.

TABLE 4.—*Average yields of crops that may be expected over a period of years under two levels of management on the soils of Knox County, Tenn.*—Continued

Soil	Map symbol	Corn		Wheat		Oats		Lespedeza		Alfalfa		Tobacco		Pasture	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Lb.*	*Lb.*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Fullerton cherty silty clay loam, severely eroded steep phase	FL	----	----	----	----	----	----	----	----	----	----	----	----	20	50
Fullerton loam:															
Undulating phase	FB	27	52	13	22	30	46	1.0	1.8	2.4	3.1	1,200	1,600	65	125
Eroded undulating phase	FO	25	50	12	21	28	43	.9	1.6	2.3	2.8	1,100	1,500	60	110
Rolling phase	FQ	25	48	12	21	28	43	.9	1.6	2.2	2.9	1,100	1,500	55	125
Eroded rolling phase	FN	23	45	11	20	25	40	.8	1.5	2.1	2.6	1,000	1,400	50	95
Hilly phase	FP	22	38	10	18	25	38	.8	1.5	2.0	2.7	900	1,400	45	90
Eroded hilly phase	FM	20	35	9	18	20	35	.7	1.4	1.9	2.4	800	1,300	40	85
Greendale silt loam:															
Undulating phase	GD	32	55	15	24	32	47	1.2	1.9	2.5	3.2	1,600	2,100	95	145
Rolling phase	GC	27	50	14	22	30	42	1.1	1.7	2.3	2.9	1,500	2,000	90	135
Greendale cherty silt loam:															
Undulating phase	GB	22	45	11	20	28	40	1.0	1.7	2.2	2.9	1,000	1,400	75	105
Rolling phase	GA	20	40	10	19	25	35	.9	1.5	2.0	2.7	900	1,300	70	100
Gullied land:															
Armuchee and Litz soil materials	GE	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Fullerton and Talbott soil materials	GF	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sequoia and Montevallo soil materials	GG	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Talbott and Decatur soil materials	GH	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Tellico and Muskingum soil materials	GK	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Guthrie silt loam [2]	GL	----	28	----	----	----	----	.4	1.2	----	----	----	----	35	60
Hamblen fine sandy loam	HA	35	55	----	----	----	----	1.4	1.9	----	----	----	----	75	110
Hamblen silt loam	HB	40	60	----	----	----	----	1.5	2.0	----	----	----	----	110	140

Huntington silt loam	Hc	45	65	15	20	37	60	1.6	2.0	3.2	3.8	1,500	1,900	120	150
Low-bottom phase	Hd	52	70	14	18	----	----	1.6	2.0	----	----	----	----	120	150
Jefferson loam, eroded rolling phase	Jd	22	42	9	17	20	32	.7	1.4	2.0	2.6	800	1,200	45	90
Jefferson and Montevallo loams:															
Eroded undulating phases	Jc	18	30	9	15	18	30	.7	1.4	1.7	2.4	700	1,100	40	80
Eroded rolling phases	Jb	18	30	8	14	15	28	.6	1.2	1.6	2.3	600	1,000	35	70
Jefferson and Montevallo clay loams, severely eroded rolling phases	Ja	----	----	4	10	8	20	.2	.8	----	----	----	----	25	45
Leadvale and Cotaco loams:															
Undulating phases	Lb	32	52	12	18	26	40	1.0	1.6	----	----	900	1,400	85	140
Rolling phases	La	30	50	11	17	24	36	.9	1.6	----	----	800	1,300	80	135
Leadvale and Whitesburg silt loams:															
Undulating phases	Ld	40	55	13	20	28	45	1.1	1.7	----	----	1,000	1,500	90	145
Rolling phases	Lc	38	52	12	18	26	42	1.0	1.6	----	----	900	1,400	85	140
Limestone rockland:															
Rolling and hilly	Le	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Steep	Lf	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Lindside silt loam	Lg	45	63	----	----	----	----	1.6	2.0	----	----	----	----	115	150
Made land	Ma	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Melvin silt loam [2]	Mb	----	40	----	----	----	----	.6	1.8	----	----	----	----	40	110
Montevallo silt loam, steep phase	Mg	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Montevallo shaly silt loam:															
Eroded steep phase	Me	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eroded hilly phase	Mc	----	----	----	----	----	----	----	----	----	----	----	----	15	40
Eroded rolling phase	Md	12	20	7	12	10	22	.4	.9	----	1.6	----	----	20	50
Eroded undulating phase	Mf	15	22	8	14	13	25	.5	1.0	----	1.7	----	----	25	55
Muskingum stony fine sandy loam, steep phase	Mn	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Muskingum–Lehew fine sandy loams:															
Steep phases	Mm	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Eroded steep phases	Mk	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Hilly phases	Ml	----	----	7	15	11	25	.5	1.1	----	----	----	----	30	45
Eroded hilly phases	Mh	----	----	5	10	9	20	.4	1.0	----	----	----	----	25	35
Neubert loam:															
Undulating phase	Nb	42	63	16	27	35	57	1.2	1.9	2.8	3.4	1,600	2,100	110	145
Rolling phase	Na	40	60	15	26	32	52	1.1	1.8	2.7	3.3	1,500	2,000	100	140

See footnotes at end of table.

TABLE 4.—*Average yields of crops that may be expected over a period of years under two levels of management on the soils of Knox County, Tenn.*—Continued

Soil	Map symbol	Corn		Wheat		Oats		Lespedeza		Alfalfa		Tobacco		Pasture	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Lb.*	*Lb.*	*Cow-acre-days* [1]	*Cow-acre-days* [1]
Nolichucky gravelly loam, eroded rolling phase	Nc	20	42	10	19	----	----	.7	1.4	1.6	2.1	900	1,300	50	95
Ooltewah silt loam	Oa	45	63	13	20	27	47	1.6	2.0	----	----	----	----	115	145
Prader silt loam [2]	Pa	----	38	----	----	----	----	.6	1.8	----	----	----	----	40	100
Roane silt loam	Ra	30	50	14	23	----	----	1.0	1.7	2.4	3.0	1,200	1,700	80	110
Sequatchie fine sandy loam	Sa	35	55	15	25	28	47	1.1	1.9	2.5	3.2	1,400	1,800	65	110
Sequoia silt loam, undulating phase	Sh	25	42	14	24	32	48	1.0	1.7	2.3	3.0	1,000	1,400	65	110
Sequoia silty clay loam:															
Eroded undulating phase	Sl	22	40	13	22	28	45	.9	1.5	2.2	2.7	900	1,300	55	100
Severely eroded undulating phase	Sn	8	25	4	9	10	22	.4	.9	1.3	2.0	----	----	35	60
Sequoia silt loam, rolling phase	Sg	22	38	11	20	26	40	.9	1.5	2.1	2.8	900	1,300	50	100
Sequoia silty clay loam:															
Eroded rolling phase	Sk	20	35	10	18	22	38	.7	1.4	2.0	2.5	700	1,100	40	85
Severely eroded rolling phase	Sm	----	20	3	8	10	18	.3	.8	1.1	1.7	----	----	25	50
Sequoia-Bland silty clay loams:															
Eroded undulating phases	Sd	20	38	12	20	26	43	.8	1.4	2.1	2.6	800	1,200	45	95
Eroded rolling phases	Sc	18	32	9	16	20	35	.6	1.3	1.8	2.3	700	1,000	35	80
Severely eroded rolling phases	Sf	----	20	3	8	9	17	.3	.8	1.0	1.6	----	----	20	45
Eroded hilly phases	Sb	----	----	7	16	18	32	.5	1.2	1.5	2.0	----	----	30	70
Severely eroded hilly phases	Se	----	----	----	----	----	----	----	----	----	----	----	----	20	40
Staser silt loam	Sr	45	65	14	20	32	47	1.4	2.0	3.0	3.5	1,400	1,800	115	145
Staser fine sandy loam	So	38	58	----	----	30	45	1.0	1.8	2.5	3.2	1,350	1,700	80	115
Low-bottom phase	Sp	40	60	----	----	----	----	1.2	1.9	----	----	----	----	80	115
Stony rolling land, Colbert and Talbott soil materials	St	----	----	----	----	----	----	----	----	----	----	----	----	25	60
Stony hilly and steep land, Colbert and Talbott soil materials	Ss	----	----	----	----	----	----	----	----	----	----	----	----	20	45

Stony very steep land, Muskingum soil materials	Su	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Talbott silty clay loam:															
Eroded undulating phase	TB	25	48	14	24	30	47	1.0	1.6	2.6	3.1	1,000	1,400	75	110
Eroded rolling phase	TA	25	45	13	23	27	42	.9	1.5	2.3	2.8	900	1,300	65	105
Severely eroded rolling phase	TD	----	----	5	10	12	20	.4	1.0	1.2	1.9	----	----	35	60
Severely eroded hilly phase	TC	----	----	----	----	----	----	----	----	1.0	1.6	----	----	30	50
Tellico loam:															
Hilly phase	TM	20	35	9	17	22	36	.8	1.5	1.9	2.5	800	1,300	45	85
Eroded hilly phase	TH	18	33	8	16	18	33	.7	1.4	1.8	2.3	700	1,200	40	80
Tellico clay loam, severely eroded hilly phase	TE	----	----	4	10	10	20	.3	.9	1.1	1.7	----	----	25	50
Tellico loam:															
Steep phase	To	----	----	----	----	----	----	----	----	----	----	----	----	35	60
Eroded steep phase	TL	----	----	----	----	----	----	----	----	----	----	----	----	30	55
Tellico clay loam, severely eroded steep phase	TG	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Tellico loam:															
Rolling phase	TN	25	50	11	20	26	40	.9	1.6	2.2	2.8	1,000	1,400	55	100
Eroded rolling phase	TK	20	40	10	19	22	38	.8	1.5	2.0	2.6	900	1,300	45	85
Tellico clay loam, severely eroded rolling phase	TF	10	28	5	10	11	23	.4	1.0	1.2	1.9	----	----	35	60
Tyler silt loam [2]	TP	----	28	----	----	----	----	.4	1.0	----	----	----	----	30	80
Waynesboro loam:															
Eroded undulating phase	WD	30	53	14	24	30	50	1.0	1.7	2.7	3.4	1,300	1,800	75	120
Eroded rolling phase	WC	25	50	13	22	27	47	.9	1.6	2.5	3.1	1,200	1,700	70	110
Eroded hilly phase	WB	23	38	10	19	23	40	.8	1.5	2.1	2.7	----	----	60	95
Waynesboro clay loam, severely eroded hilly phase	WA	----	----	----	----	----	----	----	----	1.0	1.8	----	----	30	60
Wolftever silty clay loam:															
Eroded undulating phase	WF	25	42	14	24	30	55	.9	1.5	2.5	3.0	900	1,100	80	125
Eroded rolling phase	WE	22	38	10	19	27	47	.7	1.3	2.1	2.6	----	----	65	110

[1] The term "cow-acre-days" is used to express the carrying capacity of pasture land; it is the product of the number of animal units carried per acre multiplied by the number of days during the year the animals can be grazed without injury to the pasture. For example, the soil able to support 1 animal unit per acre for 360 days of the year rates 360; a soil able to support 1 animal unit on 2 acres for 180 days of the year rates 90; and a soil able to support 1 animal unit on 4 acres for 100 days rates 25.

[2] Yields in column A are those to be expected without the benefit of artificial drainage; yields in column B are those to be expected with adequate drainage.

The yields in columns B represent the expected yields of crops under good management. The term "good management" refers to (1) the proper choice and rotation of crops; (2) the correct use of commercial fertilizers, lime, and organic manures; (3) proper tillage methods; and (4) mechanical means of water control—all designed to maintain and improve the productivity and workability of the soil and conserve soil material, plant nutrients, and soil moisture within the range of practicality.

Present knowledge of the requirements for good management of specific soils for specific crops is limited; but some of the deficiencies of the soils are known with reasonable certainty, and the probability of others is fairly well determined. From this relatively small amount of information, some of the requirements for good management of the soils are presented in the section on Soil Types and Phases and in the section on Use and Management Requirements of Groups of Soils. The good management for an individual farm depends on circumstances peculiar to that farm. The requirements for good management of any particular soil therefore cannot be applied exactly to every farm, but must be applied with the modifications required by the circumstances peculiar to the farm, the operator, and his resources.

The expected yields in columns B are also based largely upon estimates of men experienced in local soils and crops. The factors considered in making these estimates are the known deficiencies of the soil and the increases in yields of crops that seem reasonably obtainable when these deficiencies are corrected within practical limits. Some soil deficiency unknown at present may invalidate the predictions. The yields listed in columns B, however, give the best present estimates of the responses expected from good management when they are compared with yields in columns A. They may be used as production goals attainable by feasible good management practices. The means of attaining these goals may vary somewhat, but in general include the main features of good management as described for the different management groups of soils. More intensive management will bring profitable increases in yields on practically all soils in Knox County.

OTHER SOIL GROUPINGS

Although each soil mapped in this county is distinct from the others in one or more characteristics, several may be similar from the standpoint of some particular purpose or objective. In the section on Use and Management Requirements of Groups of Soils, the soils are placed in 20 groups for the purpose of discussing their requirements for proper management. By thus grouping the soils, some of the repetition required when the management needs of each soil are discussed individually is avoided.

There are many ways in which the soils can be grouped for particular purposes. For example, if one wanted to select soils suited to alfalfa or tobacco, he could refer to the information about the soils and their use and be able to group them according to their suitability for either of these crops. Or, if depth to bedrock or slope were of particular significance to the problem, a grouping could be made to show the steep shallow soils and the deep gently sloping soils.

Two such groupings of possible interest are (1) according to use suitability, that is, to relative suitability or desirability for farming, and (2) according to geographic association of the soils. The use suitability group for each soil is given in the management group tables in the section on Use and Management Requirements of Groups of Soils, and in supplement—Knox County, Tenn., soils: Summary of Important Characteristics. The geographic associations are shown on the Tipton quadrangle of the soil map.

USE SUITABILITY GROUPS

In this classification, the soils are grouped according to their relative suitability for the agriculture of the area. In determining the relative standing of the groups, suitability for crops requiring tillage was given more weight than suitability to pasture or forest. First-, Second-, and Third-class soils are considered suitable for the production of crops as well as pasture and forest; First-class soils are the most suitable, and Second-class soils next in order. Fourth-class soils are not considered well suited to the production of crops, but are suited to pasture as well as forest. Fifth-class soils are not considered well suited to the production of either crops or pasture and are therefore limited chiefly to forest.

The soils were placed in these five use suitability groups by comparing their productivity, workability, and conservability. Information for this purpose was obtained from farmers, soil surveyors, extension workers, experiment station workers, and others who deal with the soil. Soils for which information based on experience is lacking were assigned to the proper class by comparing their characteristics with those of soils for which this information has been obtained.

This grouping is not to be taken as a recommendation for use. Its purpose is to provide information as to the relative desirability of the various soils for the present agriculture of the area. Knowledge of the particular circumstances applying to a specific farm is necessary in making recommendations for land use on that farm.

There is a correlation between this use suitability grouping and the management requirement groups. Management groups 1A to 1N consist of First-, Second-, and Third-class soils; management groups 2A to 2E consist of Fourth-class soils; and management group 3A consists of Fifth-class soils.

The five groups, or classes, of soils according to their relative suitability for farming are described in the following pages.

FIRST-CLASS SOILS

First-class soils are productive, easy to work and conserve, and consequently physically well suited to the production of crops common to the county. They are good to excellent soils for crops that require tillage and for permanent pasture.

All are relatively well supplied with plant nutrients and fairly well supplied with organic matter when compared with other soils of this county, but they are responsive to fertilization for some crops. They contain more lime than most other soils of the county, but many become deficient when cropped. All are well drained but have physical properties favorable for holding moisture available to plants and for

normal circulation of air and moisture. Roots penetrate all parts of the subsoil freely. Good tilth is easily obtained and maintained, and the range of moisture conditions suitable for tillage is comparatively wide.

These soils have no prominent adverse soil conditions. They are almost free of stone, have relief favorable to soil conservation and tillage, and are not severely eroded or highly susceptible to erosion. The natural fertility is relatively high.

SECOND-CLASS SOILS

Second-class soils are physically good for agriculture. They are fair to good soils for crops that require tillage and fair to excellent soils for permanent pasture. They are at least moderately productive of many of the crops commonly grown in the area.

The physical properties of Second-class soils are at least moderately favorable for tillage, maintenance of good tilth, and normal circulation and retention of moisture. None occupies slopes greater than 12 percent, contains enough stones to interfere seriously with tillage, or is severely eroded. Each, however, is moderately deficient in one or more properties that contribute to productivity, workability, or conservability; but not so seriously deficient as to be poorly suited to crops requiring tillage.

The deficiencies vary widely among the soils. Some are fertile but are sloping and moderately eroded; others are almost level and uneroded but are relatively low in content of plant nutrients or have restricted drainage. Management requirements vary widely because of the many different kinds of soils included.

THIRD-CLASS SOILS

Physically, Third-class soils are fair for agriculture. They are poor to fair for crops that require tillage and are fair to good for permanent pasture.

Each soil is so deficient in workability, conservability, productivity, or in some combination of the three that the physical suitability for crops requiring tillage is limited. They are better suited than the Fourth-class but less suited than Second-class soils. One or more of such conditions as low content of plant nutrients, low content of organic matter, low water-holding capacity, undesirable texture, structure, or consistence, strong slope, stoniness, or inadequate natural drainage limit the physical suitability for crops that require tillage. Because of the diversity of characteristics among the soils of the group, management requirements have a wide range.

FOURTH-CLASS SOILS

Fourth-class soils are physically poor for crops that require tillage and poor to good for permanent pasture. They are poor soils for agriculture, mainly because of their limited number of well-suited uses. Some, however, may be very important on farms where soils suited to permanent pasture are in great demand.

Soils of this group are so difficult to work or to conserve, or both, that management practices necessary for their successful use for tilled crops are not feasible under present conditions. On some farms, however, the acreage of soils well suited physically to tilled crops

may be so limited that the intensity of soil management necessary for successful use of some Fourth-class soils for those crops would be practical.

These soils are generally used for pasture on farms where there are adequate acreages of soils well suited to crops. A considerable acreage is used for crops, mainly on farms where the acreage of better suited soils is too small to satisfy the needs of the farm unit. The management practiced on the areas of these soils used for crops is generally not adequate for good soil conservation. As for Third-class soils, management requirements on these soils, both for crops requiring tillage and for pasture, vary widely.

FIFTH-CLASS SOILS

Fifth-class soils are very poorly suited to agriculture. They are very poor for crops that require tillage and poor to very poor for permanent pasture. Each soil of this group is so low in productivity or so difficult to work or conserve, or has such combinations of these unfavorable properties, that the intense management necessary for successful use for crops is generally not feasible. Each is low enough in plant nutrients or has such poor moisture relationships, or both, that common pasture plants produce very little feed. Under present conditions these soils are apparently best suited to forest, though they are less productive of trees 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, even though they are poorly suited to such use.

SOIL ASSOCIATIONS

A study of the detailed soil map of this county shows that the soils occur in several different patterns, or associations, that differ from each other in kind, proportion, or distribution of the component soils or in all three properties. It will be observed for example, that the soils on Copper Ridge and Blackoak Ridge are chiefly of the Fullerton and Clarkville series, but irregular strips of Greendale and Lindside soils occur along the drainageways. In this area the relief consists of broad rolling ridge tops associated with fairly long moderately strong slopes. More careful study of the descriptions of the soils of the ridge lands will show that they are of only moderate fertility but well drained and deep to bedrock. Furthermore, it will be seen that the landscape consists predominantly of an intricate pattern of soils moderately to fairly well suited to crops requiring tillage, which are intermingled with soils suited to pasture but not crops.

In contrast with this landscape, the area in Hinds Valley consists of a pattern predominantly of Jefferson and Montevallo soils, with strips of Leadvale soils along a well-defined drainage system. The lay of the land is that of an undulating to rolling valley, and the soils are mostly low in fertility, strongly acid, and shallow to shale bedrock. In the vicinity and southwest of Farragut along United States Highway No. 70, the landscape is dominated by Decatur, Dewey, and Emory soils and the relief is very gently sloping to rolling. The soils here are notably fertile, well drained, and moderately deep to deep over bedrock.

Each of these associations is relatively uniform as to the kinds of soils and patterns of soils that comprise it. Nevertheless, the individual soils in the pattern may differ greatly from each other.

A farm in one part of such an association is likely to have problems and potentialities similar to farms of equivalent size in other parts of it. What is learned about farm management in one part of an association will have some prediction value for farms in other parts of the association. In contrast, each of the soil associations is distinct from the other associations in one or more features significant in determining the suitability and management requirements of farms. Accordingly, problems common to the farms in one soil association may be unlike those in another association.

Because it shows areas wherein farms of equivalent size are likely to have similar problems and potentialities, the map delineating soil association areas can be useful in planning those activities related to the possibilities of whole farms, such as highways, electric services, and other public facilities. It also shows areas from which sample farms can be selected for research or demonstration purposes.

FULLERTON-BOLTON-CLARKSVILLE SOIL ASSOCIATION

The Fullerton-Bolton-Clarksville soil association (pl. 13, *A*) occupies the cherty ridge section. The relief consists of relatively broad, rounded ridge tops and moderately long strong slopes and numerous sinkholes. Strips along the northwestern edge of some of the cherty ridge sections, or belts, have a predominantly steep slope. The drainage system is only moderately defined, since a notable part of the water drains into sinkholes. Fullerton soils predominate, although in some places the Clarksville soils occupy a greater part. Bolton soils occupy smaller widely distributed areas, mainly in association with the Fullerton soils. Soils consisting of alluvium make up a smaller part of the landscape than in some other associations of the county.

In general, drainage is good. The proportion of soils having a nearly level surface or slow internal drainage is very small. The general level of fertility is moderate to low, and practically all of the soils are medium or strongly acid. On the other hand, nearly all are permeable and have a considerable depth to bedrock. A moderate amount of chert is common to most of the acreage. In some places it interferes with tillage and in a very few it prohibits it.

Probably 80 percent of this association is cleared. The steepest and most cherty parts are largely in forest. There is a notable idle acreage that would be suitable for tilled crops if it were well managed. The most extensive forested parts are the steep strips along the northwestern edge of some of the cherty ridge belts.

General farming, or growing of a cash crop, corn, small grains, hay, and pasture prevails. Tobacco is the usual cash crop, although truck crops for the Knoxville market are grown in some places. Oats and wheat are the most common small grains. Lespedeza, redtop, and, in places, red clover are the most common hay crops. Although these soils are not so well suited to pasture as some of the soils of other associations, production of livestock, chiefly beef and dairy cattle, is common.

This association has a fairly large proportion of soils fairly well to moderately well suited to crops requiring tillage, and much of the rest is suited to pasture. Under good management, which includes relatively heavy fertilization, liming, increasing the organic-matter content, and use of moderately long rotations, these soils respond well and are suited to a wide variety of crops. Though they are subject to erosion, this hazard is not so marked as on soils of some of the other associations in the county.

STONY LAND-TALBOTT SOIL ASSOCIATION

The Stony land-Talbott soil association (pl. 13, *B*) occupies valley positions and is characterized by a smooth to rolling surface and many limestone outcrops. In places rolling stony land and limestone rockland types predominate; in others, Talbott or Colbert soils. Talbott, Colbert, and Sequoia soils are always intermixed with the stony land types, and though less extensive in many places, their acreage is significant in agriculture. Strips of Lindside and Greendale soils are common along the drainageways, but these alluvial soils in some of the association areas occupy only a small part of the landscape. Sinkholes are abundant, and as a result the surface drainage system is not well defined. The depth to bedrock in the soil areas is shallow. Much of the acreage is moderately fertile, however, and fairly well drained. The subsoil and, in many places the plow layer, is heavy or compact clayey material.

About half the acreage is cleared, and much of this is used for pasture. Corn and hay predominate on a few cultivated areas. Approximately half the acreage in this association is too stony for tillage, and a third of this stony land is so devoid of soil material as to be valueless for pasture. The rest is capable of producing good legume-grass pasture. The carrying capacity on much of it is limited, however, and in most places rock outcrops prevent use of mowing machines for weed control. The Talbott, Sequoia, Lindside, and Greendale soils, which occupy the less stony half of this association, are well suited to such crops as hay and small grains. These soils are poorly suited to truck crops because of their heavy compact subsoils. The more sloping parts are generally not well suited to row crops.

MUSKINGUM-LEHEW SOIL ASSOCIATION

The Muskingum-Lehew soil association (pl. 14, *A*) occupies relatively narrow strips that consist of a steeply sloping ridge with a very narrow crest. These ridges extend in a northeast-southwest direction across the county and are adjacent to shale valleys. Surface drainage is very rapid. Except for small areas of colluvial material at the base of the slopes where drains have deposited material washed or sloughed from the ridges, the soils are shallow to bedrock. Muskingum and Lehew soils occupy a great part of the acreage and their areas are intricately mixed.

A large part is under mixed deciduous and pine forest. Much of the extremely limited acreage of colluvial soils is cleared and used either for crops or pasture. A small part of the less steep parts of the Muskingum-Lehew soils is also cleared and used for these purposes. Practically all of this association is included in farms, the crop acreage of which is on soils of other associations better suited to

cultivation. Steep slope, shallow depth to bedrock, and low natural fertility limit the suitability of the Muskingum-Lehew areas chiefly to forest.

JEFFERSON-MONTEVALLO SOIL ASSOCIATION

The Jefferson-Montevallo soil association (pl. 14, *A*) occupies valley positions. The underlying rock is predominantly acid shale. Practically all of the areas lie as undulating to rolling strips adjacent to areas of the Muskingum-Lehew soil association. A few steeper narrow strips and a notable acreage of gently sloping or nearly level colluvial soils, chiefly of the Leadvale and Cotaco series, occur along the drains. Jefferson soils predominate on the parts adjacent to the Muskingum-Lehew ridges, and the Montevallo elsewhere.

The soils of this association (pl. 14, *B*) are generally low in fertility, strongly acid, and, except for the soils on alluvium and colluvium, shallow to shale bedrock. A large part has been cleared and cropped, and as a result most of the upland soils have been moderately to severely eroded. In many places erosion has been so great that the soil will be unsuited for either crops or pasture until extensive measures are taken to fill in the gullies, increase the fertility, and establish a good grass cover. Third- and Fourth-class soils predominate, although Fifth-class soils are common in places. There is a small acreage of Second-class soils.

Farming for production of crops used by the farm family prevails in the less productive parts, and idle land is common. Corn and pasture occupy much of the acreage in such sections, and crop yields and the carrying capacity of pasture are low. In the more productive parts a more general type of farming is practiced, and on a few farms where good management prevails fairly high yields of corn, small grains, hay, and pasture are produced. A large part of the acreage is suited to general farming. In order to establish and maintain a relatively high level of production, however, particularly good management is required, chiefly because the more extensive soils are prevailingly of low fertility and greatly susceptible to erosion.

CUMBERLAND-HUNTINGTON SOIL ASSOCIATION

The Cumberland-Huntington soil association consists of bottom lands and associated high stream terraces along the Holston, French Broad, Tennessee, and Clinch Rivers. Most areas are in the meanders of these streams and are from a fraction of a square mile to about 1½ square miles in size. The separate areas generally consist of an irregular strip or belt of nearly level bottom land adjacent to the river channel and a higher, somewhat broader area of undulating and rolling stream terraces.

Huntington, Staser, and Lindside soils occupy most of the bottom lands along the Holston, Tennessee, and Clinch Rivers. Undulating and rolling Cumberland, Etowah, and Waynesboro soils predominate on the stream terraces, which are hilly in small areas but on the whole are fairly smooth.

The soils on the bottom lands are fertile, easily worked, and moderately drained to well drained. They were originally subject to periodic flooding, but flooding is much less frequent now that dams have been built upstream. The soils on the stream terraces are mod-

erate to high in fertility and in great part are well drained. There are sufficient cobbles in places to interfere materially with cultivation.

First- and Second-class soils predominate on the bottom lands, and Second-class soils on the terraces. A great part of the acreage in this association has been cleared and is used mainly for crops. Parts of the cleared areas on the terraces are used for pasture grown in rotation with other crops. Much of the bottom land is used intensively for row crops, chiefly corn, although some hay and truck crops are also grown. Rotations are more common on the terraces where corn, small grains, hay, and some truck crops and tobacco are grown. General livestock farming, supplemented by a cash crop, usually tobacco, prevails.

This association is one of the most productive of the county, and crop yields are relatively high. The fertility, especially of the bottom lands, is easily maintained, and the soils of the terraces are well suited to a variety of crops without especially exacting management. Soils on the bottom lands are suited to intensive row cropping and to general livestock farming supplemented by a limited acreage of cash crops.

DECATUR-DEWEY-EMORY SOIL ASSOCIATION

The Decatur-Dewey-Emory soil association occupies irregular valley areas overlying relatively high grade limestone. It mainly occurs adjacent to areas of the Fullerton-Bolton-Clarksville soil association. The surface is predominantly undulating to rolling, and internal drainage of practically all of the soils is moderately good to very good. A large part is occupied by very fertile smooth soils that are at least moderately deep to bedrock. The soils are considered to be strong, and high fertility is not difficult to maintain. First- and Second-class soils predominate, but on the more sloping parts careful attention is required in controlling erosion.

Most of the acreage has been cleared and is used mainly for crops or pasture. General livestock farming prevails; corn, small grains, and legume hay and pasture crops are grown. Some of the most productive farms have a part or all of their acreage in this association, which includes some of the most productive parts of the county. The areas are well suited to livestock farming. They are naturally productive of legumes and grasses, although some liming and fertilization are required to maintain high fertility. Many of the uneroded soils in this association are productive of truck crops, whereas most of the eroded soils are not suited to truck crops because of their poor tilth.

SEQUOIA-LITZ-DANDRIDGE SOIL ASSOCIATION

The Sequoia-Litz-Dandridge soil association (pl. 15, *A*) consists predominantly of soils developed over interbedded shale and limestone and calcareous shale, which have been weathered to widely variable depths. The association is undulating to hilly and occupies valley positions. It consists of low hills with moderately broad smooth crests and moderately strong slopes, and of narrow strips of imperfectly drained soils on local alluvium along the drains. Sequoia soils are on most of the smooth hill tops and make up about 60 percent of the acreage. Litz and Dandridge soils predominate on the strong slopes, and Leadvale, Whitesburg, and Lindside soils occupy the alluvial strips.

Internal drainage is moderately slow to medium; surface runoff is medium to very rapid. The general fertility ranges from low to medium for the Sequoia, Litz, and Dandridge soils, and from medium to high for the Leadvale and Lindside soils.

Third-, Fourth-, and Fifth-class soils predominate, although the Lindside and some of the Leadvale and Sequoia soils are of the Second class. General farming predominates; corn, wheat, oats, and hay are the chief crops. A great part of this association has been cleared and cropped, but a considerable acreage in the more sloping areas has been severely eroded and greatly lowered in productivity. Much of this eroded acreage is now either idle or used as unimproved pasture.

Strong slope, shallow depth to bedrock, and generally eroded condition make especially careful management necessary if the productivity of the soils in this association is to be built up and maintained. The smoother, less eroded areas are moderately productive of most farm crops and pasture when farmed under a good system of management. The other areas can be made to produce good grazing. A system of farming that maintains a large acreage of pasture and hay crops on the more sloping parts is well suited. Moderately long rotations consisting of hay, small grains, and infrequent row crops are satisfactory on the smoother less eroded Sequoia soils. The Leadvale, Whitesburg, and Lindside soils are suited to intensive use, providing their fertility is maintained. The Litz, Dandridge, and the severely eroded Sequoia soils are not well suited to crops requiring tillage. This association generally is much less desirable for truck crops than some of the other associations in which deeper, more friable, smooth soils are common.

DANDRIDGE-LITZ-LEADVALE SOIL ASSOCIATION

The Dandridge-Litz-Leadvale soil association differs from the Sequoia-Litz-Dandridge association chiefly in having stronger slopes, prevailingly hilly and steep. It occupies moderately large areas in the northern and eastern parts of the county. Dandridge and Litz soils are much more extensive than Sequoia soils. The average depth to bedrock is notably shallow, and surface runoff on much of the acreage is very rapid. Internal drainage is adequate, but the capacity for holding moisture is limited.

Possibly 35 percent of the acreage has been cleared, and much of the upland has been greatly damaged by erosion. Fourth- and Fifth-class soils prevail on the uplands. Corn, hay, and pasture are the main crops of this association. Much of the acreage now lies idle or has been abandoned to volunteer forest. On some areas farming for home use prevails; on others, livestock farming. Soils well suited to crops requiring tillage are limited chiefly to the narrow strips of bottom land along the streams and drainageways.

Much of this association is not well suited to intensive use, mainly because of strong slope, relatively shallow depth to bedrock, and, in places, severe erosion. If properly fertilized, much of the upland is well suited to pasture and, accordingly, well suited to livestock farming in which long rotations consisting principally of legume hay and pasture crops are used. The more limited but significant and widely

distributed soils on the nearly level valley floors are well suited to intensive farming. Practically every farm in this association has some acreage on these smooth alluvial soils.

TELLICO-NEUBERT SOIL ASSOCIATION

The Tellico-Neubert soil association occupies a predominantly hilly to steep landscape in which Tellico soils are the most extensive. A smaller but significant acreage of Neubert and Hamblen soils is on the colluvial slopes and along the drainageways and creeks. The soils generally are a reddish loam that is moderately fertile and permeable. The steeper parts are shallow to bedrock, and those less steep are moderately deep.

Fourth- and Fifth-class soils predominate in this association; but on the ridge tops, most of which are narrow, and on the bottom lands and colluvial slopes Second- and Third-class soils prevail. A large part of the acreage suitable for crops has been cleared. The steepest slopes are not well suited to either crops or pasture and are largely under forest. Some hilly and steep areas once cropped are now under reestablished pine forest. In most parts of the association, forest occupies much of the land.

Farms usually consist mostly of forested areas; the cropland is confined to the broader ridge tops, colluvial slopes, and bottom lands. General farming and truck crop production prevail. The smoother Tellico and Neubert soils are favored, especially for early market vegetables. Some of the hilly slopes are used for pastures that provide good grazing when properly fertilized and protected from erosion.

ARMUCHEE-LEADVALE SOIL ASSOCIATION

The Armuchee-Leadvale soil association is predominantly hilly and steep and shallow to shale and limestone bedrock. It occurs as an irregular belt in the northern part of the county. There are narrow strips of smooth Leadvale soils along the drains, and some rolling areas of Sequoia soils, moderately deep to bedrock, on the ridge tops. Nevertheless, the shallow hilly and steep Armuchee soils greatly predominate.

Probably two-thirds of the association has been cleared, and much of the cleared hilly and steep part has been severely eroded. Some of this has grown up in pine forest.

This association is not well suited to systems of farming in which tillage of a large part of the farm is required. Much of it is not suited to crops, except those grown in very long rotations, but is capable of producing good quality pastures. Bluegrass and white clover grow well where the natural fertility has been replenished or has not been greatly reduced. The steepest and most severely eroded areas cannot be expected to be especially useful as pasture and are suited chiefly to forest. Crops grown in moderate to short rotations are confined mainly to the smooth strips along the drains and creeks.

STASER-HAMBLEN SOIL ASSOCIATION

The Staser-Hamblen soil association occupies the first bottoms along Bullrun Creek, which is in the northern part of the county. Ham-

blen soils predominate, but Staser soils and soils of low stream terraces occupy a smaller part. In most places the soils are nearly level, of moderate to high fertility, and not especially acid. Practically all the acreage is subject to periodic flooding. This association usually makes up a part of farms that lie in adjacent associations, chiefly the Armuchee-Leadvale. Because the Armuchee-Leadvale does not have a large acreage of soils suited to crops, a great part of the cropped acreage on the farms is within the Staser-Hamblen association.

A large part has been cleared and is used rather intensively for crops on farms producing general livestock. Corn occupies an extensive acreage, and hay, pasture, and some small grains the rest. Yields are moderate under usual conditions but very high under good management.

The soils of this association are not difficult to maintain at a fairly high level of fertility. The workability is good, except where affected by flooding, and erosion is not serious. A small acreage may be damaged by deposits of unproductive sand or clayey subsoil material carried from actively eroding areas in the adjacent upland.

BLAND-CAMP SOIL ASSOCIATION

The Bland-Camp is one of the less extensive soil associations. It occurs in a strongly dissected belt in the eastern part of the county. This belt consists mainly of the hilly and steep dusky red Bland soils but has narrow areas of rolling Bland soils on the ridges and narrow strips of Camp soils along the draws. These soils have moderate natural fertility but their rather slow permeability and predominantly strong slopes promote rapid erosion when the soil is tilled.

A considerable part of the steep and some of the hilly areas are under cut-over native forest. Much of the Camp, as well as smaller but notable parts of the hilly and steep Bland soils, have been cleared. A large part of the hilly and steep and some of the rolling Bland soils have been abandoned as crop land after being severely eroded and have grown up in shortleaf and Virginia pines.

Much of this association is not well adapted to farming, although the Camp and the rolling Bland soils are suited to crops. The size of the suitable areas is small, as they are closely flanked by extensive hilly and steep areas of limited value for pasture or forest.

SEQUOIA-LEADVALE SOIL ASSOCIATION

The Sequoia-Leadvale soil association occupies predominantly undulating to rolling valley positions over calcareous shale and interbedded shale and limestone. On the smoother parts of the low ridges the depth to bedrock is 2 to 3½ feet, but on the more exposed slopes it is less. The alluvial soils along the drains occupy an appreciable acreage and are more than 3 feet deep to bedrock. A great part of the upland has been eroded. Many of the more sloping areas now have a plow layer consisting of clayey subsoil material. There is also an extent of gullied land on areas that were cultivated without adequate control of runoff.

A great part of this association has been cleared (pl. 15, *B*) and much is now used for general livestock farming. Corn, small grains, and legume and grass hay and pasture crops predominate. In some

places a notable acreage lies idle; its productivity has been greatly reduced by erosion losses.

The soils of this association generally are subject to serious erosion when cultivated and are not among the most fertile in the county. Nevertheless, they are suited to general farming in which livestock production is important. Second- and Third-class soils predominate; Fourth- and Fifth-class soils occupy the more sloping eroded parts. The smoother parts of the upland, chiefly Sequoia soils, are suitable for crops if moderately long rotations are used and adequate fertilization is practiced. The alluvial soils along the streams and drains are well suited to intensive use but will require fertilization to keep yields high. Most of the soils are capable of producing good pasture under proper management.

SEQUOIA-BLAND SOIL ASSOCIATION

The Sequoia-Bland soil association (pl. 16, *A*), like the Sequoia-Leadvale, occupies undulating to rolling valley positions. It consists of an intricate pattern of Bland and Sequoia soils with strips of Leadvale and Lindside soils along the drains. The soils are shallow to interbedded shale and dusky red argillaceous limestone bedrock. The range in slope is a little greater than for the Sequoia-Leadvale association and an appreciable part is hilly or strongly sloping.

A great part has been cleared and was frequently cropped in the past (pl. 16, *B*). Erosion has been active on much of it. General livestock farming is now practiced and appears to be well suited. Corn, hay, small grains, and pasture are important crops. The upland part is not high in productivity because it is eroded and gullied. The limited acreage of soils on local alluvium is of moderate productivity and is suited to such crops as corn and grasses and legumes for hay and pasture. Third- and Fourth-class soils predominate on the upland, and Second-class soils on most of the bottom land.

MONTEVALLO SOIL ASSOCIATION

The Montevallo soil association is relatively small. Most of it lies as an irregular narrow strip southeast of Bullrun Creek and parallel to it. It consists predominantly of rolling and hilly Montevallo soils with small colluvial strips along the drains. With the exception of these colluvial areas, the soils are shallow to very shallow to acid shale bedrock. They are low in fertility, medium to strongly acid, and very limited in capacity for holding moisture available to crops. Much of the smoother part has been cleared and cropped at some time but is now largely abandoned or idle. A notable acreage has been very severely eroded and is now in shortleaf and Virginia pines. Parts of the hilly areas are still under native forest.

A great part of this association is poorly suited to crops or pasture. The smoother areas possibly can be made to produce sufficient pasture, though much of the acreage should be returned to forest. The limited areas of colluvial soils are suited to crops, but the strips are so narrow and small that they do not form a farm unit and are not conveniently located to become a part of a farm unit that lies predominantly in another soil association.

ADDITIONAL FACTS ABOUT KNOX COUNTY

INDUSTRIES

Knoxville is an important industrial and distributing center and provides employment for many people in both the rural and urban population. Some of the more important things manufactured or processed are cotton and woolen textiles, metal castings, mine machinery, extracted manganese, cement, concrete products, marble, thermostatic control equipment, milk and meat products, flour and meal, plastics, and lumber.

TRANSPORTATION AND MARKETS

Paved, oil-surfaced, or gravelled roads reach all communities in the county. All densely populated sections are connected with Knoxville by well-maintained oil-surfaced roads. The 1950 Census shows that 621 farms were less than 1 mile from the trading center most frequently visited; 1,143 were 1 to 4 miles; 1,057 were 5 to 9 miles; and 1,210 were 10 miles or more.

The county is served by the Southern Railway and the Louisville and Nashville Railroad. Lines extend in nine directions from Knoxville. Main lines connect with the cities of Atlanta, Chattanooga, Birmingham, Memphis, Cincinnati, Washington, and Charleston. Several interstate bus lines and many local companies operate passenger buses through and to Knoxville. Several truck lines, as well as the railroads, carry local and interstate freight. A number of airlines afford passenger, mail, and air freight facilities at the Knoxville Municipal Airport, which is 9 miles south of Knoxville.

A small amount of shipping was done on the Tennessee River in the past, but facilities were not suitable for regular and heavy barge shipments until the 9-foot slack water channel was established by the TVA system of dams. Following the completion of this project, one public and several private terminals have been built, and shipment of heavy goods such as oil and grain has increased.

Knoxville, centrally located, is the principal trading center and the chief market and shipping point for farm products in Knox County. This city is also an important distributing center for several other counties. Other shipping and receiving points on the railroads in the county are not commonly used, except for receiving and shipping materials in carload lots. Tobacco, an important money crop, is trucked from a wide area to warehouses in Knoxville, where it is sold, mostly at auction. Most dairy products are sold to the milk-distributing plants and manufacturers of ice cream, though some are marketed by retail dairymen. Vegetables and melons are sold principally to stores and on curb markets in Knoxville, or distributed to the smaller villages. Poultry and eggs are sold in Knoxville, to country stores, and to rolling stores that travel to practically all parts of the county. Although there are no commercial canning factories in the county, Knoxville has a freezing plant for fruits and vegetables. There is, however, a community cooperative canning plant at Farragut. Corn and small grains are sold mostly in Knoxville and

in a few nearby towns in adjacent counties. A number of small grist mills distributed over the county convert grains into meal and feed for local use. Hay not fed on farms is sold largely to local dairymen or feed dealers.

COMMUNITY, FARM, AND HOME FACILITIES

There are 7 senior high schools and 27 elementary schools conveniently located in the county. Ten of the county elementary schools are for Negroes. Schools operate for 9 months each year, and free bus transportation is provided for all pupils living more than 2 miles from a school. In addition to the county schools, the city of Knoxville has 1 senior high, 1 combined senior and junior high, 4 junior high, and 25 elementary schools for white; and 1 senior high, 1 junior high, and 9 elementary schools for Negro pupils.

The University of Tennessee, the Tennessee Agricultural Experiment Station, the Tennessee School for the Deaf, Knoxville College (for Negroes), and four business colleges are in Knoxville; Johnson Bible College is at Kimberlin Heights in the southeastern part of the county.

There are many churches widely distributed over the city and county. Daily mail service is provided for all rural sections, and electric power and telephone services are available in almost all sections. In 1950, 951 farm homes had telephones, and 3,804 were lighted with electricity, 3,794 of which received it from power lines.

The quality of farm buildings varies greatly. In the sections where the soils are productive, the farm buildings and fences are generally in good repair and most farm homes are equipped with modern conveniences. In areas such as the cherty ridges and the shale valleys, where the soils are less productive and other physical land features are less favorable for farming, farm improvements are only fair.

CROPS

The more significant changes in crop acreage since 1930 are (1) a reduction in corn, (2) a notable increase in oats, (3) a great increase in lespedeza and alfalfa, and (4) a notable increase in tobacco.

Corn and hay are the most important crops. Oats is the most important small grain; wheat and barley rank next. Tobacco and vegetables are important cash crops.

Corn is grown on almost every farm, either for sale or for home use. The crop is grown on almost every type of soil in the county except the very poorly drained ones and the more stony and rough land types. Yields are highest on the bottom lands and on the deep red soils of the upland. The total area in corn decreased by approximately 10,000 acres between 1939 and 1949, probably because it was replaced by small grains grown in rotation with lespedeza and improved pastures. This change in land use results from the need for conservation practices that will provide grain and at the same time afford winter cover for the land.

TABLE 5.—*Acreage of the principal crops and number of bearing fruit trees and grapevines in Knox County, Tenn., in stated years*

Crop	1929	1939	1949
Grain harvested:	*Acres*	*Acres*	*Acres*
Corn for grain	26, 530	24, 483	14, 362
Oats	1, 159	1, 173	7, 252
Wheat	3, 627	4, 340	3, 712
Rye	60	100	41
Barley	415	2, 070	892
Soybeans	[1] 5, 154	30	152
Cowpeas	[1] 1, 790	42	10
Hay	35, 165	39, 748	39, 239
Timothy and clover alone or mixed	13, 825	4, 641	2, 901
Alfalfa	1, 104	3, 237	5, 712
Small grains cut for hay	1, 687	2, 319	3, 312
Annual legumes cut for hay	6, 780	3, 013	895
Lespedeza	(2)	18, 575	21, 088
Other cultivated grasses	10, 952	6, 924	5, 331
Wild grasses	817	1, 039	(2)
Silage and forage	2, 990	1, 676	1, 414
Sorghums cut for silage, hay, or fodder	610	351	66
Potatoes for sale and home use	946	900	236
Sweetpotatoes for sale and home use	921	500	232
Market vegetables	2, 478	1, 348	724
Sweet sorghums for sirup	106	94	12
Tobacco	456	693	907
Cotton	13	34	20
Strawberries	354	158	33
	Number	*Number*	*Number*
Apple ... trees	59, 231	39, 560	19, 833
Peach ... do	98, 480	23, 472	7, 754
Pear ... do	8, 466	6, 504	2, 965
Plum and prune ... do	2, 756	2, 898	1, 078
Cherry ... do	11, 239	5, 159	2, 102
Grapevines	41, 416	53, 978	23, 340

[1] For all purposes.
[2] Not reported.

Lespedeza was the most extensive hay crop in 1949, and alfalfa ranked next. The alfalfa yield averages about 2 tons an acre, whereas the yield for all other hays is about 1 ton. Alfalfa is grown mostly on the deep, red soils of the upland but can be grown successfully on most of the well-drained upland soils if the needed amendments are applied. Moderate applications of lime and fertilizer are practically always made in preparing the soil for seeding alfalfa. Red clover is a common crop on the more fertile soils. Wilt-resistant varieties of clover are necessary in this region. Lime is generally applied, and some fertilizer is used. Timothy, redtop, and orchard grass are common hay plants. They are seeded alone or with lespedeza or red clover. These common grasses and lespedeza are not fertilized to the same extent as alfalfa and red clover.

Wheat is sown in the fall. Some fertilizer is usually applied at seeding time. Lespedeza or other legumes and grasses for hay or pasture are commonly seeded in the wheat the following spring. Oats

are commonly considered the most promising small grain for feed, and the acreage is increasing more rapidly than that of other small grains. Oats and barley are sown in the fall, and some fertilizer is generally applied at the time of seeding. Lespedeza or other legumes and grasses are usually sown in the small grain early the following spring.

Tobacco is grown almost exclusively for sale. Soils having the most suitable tilth and moisture relations are used. The seedbed is carefully prepared, and heavy applications of fertilizer are made. Yields averaged 1,333 pounds an acre in 1949.

A few farmers grow fruits and vegetables for the Knoxville market, but much of the supply for this city is produced in nearby counties or shipped in from more distant points. Vegetables grown in the county for sale are potatoes, beans, sweet corn, peas, greens (spinach, mustard, kale, turnip greens, and so on), onions, peppers, cucumbers, squash, turnips, lettuce, cabbage, okra, beets, and carrots. Peas, sweet corn, and lima beans are grown for canneries at Sevierville in Sevier County and for a freezing plant in Knoxville. Fruit is grown mostly for home use, although there is some growing of peaches, apples, and grapes on a commercial scale. Watermelons, cantaloups, tomatoes, strawberries, blackberries, and raspberries are grown to some extent for the Knoxville market.

Several nurseries produce ornamental shrubs, fruit trees, berry plants, flowers, and bulbs for local and outside markets. Farmers also sell some flowers on the curb market in Knoxville.

Favorable dates for planting some of the more important crops (7) are:

Crop:	*Planting date*
Corn	Apr. 20 to May 10 (may be planted to the middle of June).
Oats	Sept. 15 to Oct. 1 or Mar. 1 to 15.
Wheat	Oct. 10 to 20.
Barley	Sept. 20 to Oct. 7.
Alfalfa	Aug. 20 to Sept. 10 or Mar. 1 to 20.
Red clover	Aug. 1 to Sept. 10 or Mar. 1 to 15.
Lespedeza (annuals)	Mar. 1 to 30.
Orchard grass	Mar. 1 to 15 or earlier, and Aug. 20 to Sept. 20.
Timothy	Mar. 1 to 15 or Aug. 1 to Oct. 15.
Redtop	Mar. 1 to 15 or Aug. 1 to 30.
Tobacco	Feb. 1 to Mar. 1 in specially prepared beds; set in field May 10 to June 15.
Potatoes	Jan. 1 to Mar. 15 (early crop) and July 1 to 15 (second crop).
Sweetpotatoes	Start in hotbed Mar. 15 to Apr. 1; transplant to field Apr. 20 to May 15.

ROTATIONS AND FERTILIZERS

On many farms crop rotations are not systematically planned and carried out. Rotations most used are: (1) Corn, followed by a small grain seeded to lespedeza—the lespedeza to be retained for 1 or 2 additional years; (2) corn, soybeans, a small grain, and lespedeza for 1 to 3 years; (3) corn, a small grain, and red clover for 1 or 2 years; and (4) corn, a small grain, and alfalfa for 3 to 5 years. Where row crops are not suitable because of the great erosion hazard on strong slopes, a rotation consisting of a fall-sown grain and legume-and-grass hay is used by some farmers.

Most soils in this county are especially deficient in lime and phosphate. Recently the amount of lime and phosphate used in the county has increased greatly. The more progressive farmers commonly use fertilizers containing phosphorus and potassium for corn and small grains. Manure, when available, is used on corn, tobacco, and vegetables. Considerable quantities of complete fertilizer are applied for tobacco and vegetables. Mixtures of commercial fertilizers commonly used on Irish potatoes at the rate of 500 to 1,000 pounds an acre are 4–10–4, 3–8–5, 2–10–4, 5–10–5, and 4–8–8. Tobacco ordinarily receives 800 to 1,000 pounds an acre of 3–8–5, and small grains, 100 to 200 pounds an acre of 2–12–6, 0–10–4, or 16- or 20-percent phosphate. From 50 to 100 pounds an acre of nitrate of soda is applied as a side dressing for truck crops and tobacco, in addition to the 3–8–5 fertilizer they receive. Little nitrogen fertilizer is used on soils of the first bottoms.

Practically all commercial fertilizer is bought ready-mixed; little of it is purchased cooperatively. Much of the lime is a by-product from the zinc mines at Mascot. Green-manure crops such as crimson clover and vetch are grown by some farmers.

PERMANENT PASTURES

Almost every farm has several acres of permanent or rotation pasture. On some of the farms the acreage of permanent pasture is great in proportion to the acreage of cropland. Much of the permanent pasture is on poorly drained, rough, steep, or severely eroded soils. A part, however, is on good soils. The plants most common in permanent pastures are lespedeza, redtop, hop clover, and broomsedge and other volunteer plants that vary greatly in productivity and nutritive value. Where good management has been practiced, bluegrass and white clover commonly predominate in the stand. Other plants in the more productive pastures are Bermuda, orchard, and Dallis grasses.

Many rotation pastures are on soils well suited to crops that require tillage. These pastures consist chiefly of lespedeza, red clover, redtop, timothy, orchard grass, and ryegrass. Small grains and crimson clover or ryegrass afford considerable pasture late in winter and early in spring. Many fields seeded to mixed grasses and lespedeza are pastured during the spring and early summer and later cut for hay.

Much of the smooth and rolling stony land affords fair to good pasture of bluegrass and white clover. These pastures are somewhat susceptible to drought, and grazing is impaired during dry periods. Nevertheless, when moisture conditions are favorable, they provide considerable grazing.

Permanent pastures on soils developed from calcareous shales or from limestone consist largely of bluegrass and clovers. The pasture plants on soils developed from acid shale, sandstone and dolomite, as well as those on poorly drained land, are chiefly redtop, lespedeza, and wild grasses with some Bermuda grass.

Wild onions and broomsedge are prevalent weeds that notably reduce the grazing value of pastures. No practical means of exterminating wild onions has been found. Liming and fertilizing help suppress the broomsedge and many other objectionable plants. Recently there has been an increase in the acreage of both permanent and winter

pasture, and use of good management practices, such as mowing, fertilizing, liming, subsoiling, and reseeding poor stands, has increased.

LIVESTOCK AND LIVESTOCK PRODUCTS

Livestock and livestock products are important in the agriculture of the county. The number of livestock on farms is given in table 6 for stated census years.

There were 29,161 head of cattle on farms in 1950, a definite increase over the 22,427 head reported in 1940. Most of the cattle were dairy animals. Dairying is carried on both as a specialty and as an adjunct to general farming. If well managed, a large acreage in this county is well suited to pasture and feed crops, and abundant water is available for livestock. Most dairy products are sold in Knoxville, but some are sold outside the county.

Grade Jerseys predominate among the dairy breeds, although there are a number of grade Holsteins and Guernseys. The American Jersey Cattle Club lists 72 active Jersey breeders in the county. There are 10 active Holstein breeders, 10 Guernsey breeders, and 2 Ayrshire breeders.

Beef cattle are predominantly grade Aberdeen Angus and Hereford, though there are also several purebred herds. A large number of both the dairy and the beef herds are headed by purebred sires.

In 1950 a total of 12,015 hogs was reported on farms, an average of 5 for each farm reporting. Grade Duroc and Poland China predominate.

Only 1,181 sheep were reported in 1950. The Hampshire breed predominates. Spring lambs are produced largely for the local and eastern markets. They are usually sold at auction in the stockyards in June.

In 1950, 137,957 chickens were reported on 3,544 farms. Farm flocks consist largely of Plymouth Rocks, Rhode Island Reds, White Leghorns, or White Plymouth Rocks. A small percentage of the poultry income is derived from turkeys, ducks, and geese.

TABLE 6.—*Number of livestock, poultry, and beehives on farms in Knox County, Tenn., in stated years*

Livestock	1930	1940	1950
	Number	*Number*	*Number*
Horses and colts	2, 655	[1] 2, 888	[2] 2, 733
Mules and colts	3, 257	[1] 3, 094	2, 013
Cattle	22, 764	[1] 22, 427	29, 161
Swine	10, 239	[3] 10, 383	12, 015
Sheep and lambs	2, 526	[4] 1, 365	1, 181
Chickens	[1] 142, 563	[3] 139, 856	[3] 137, 957
Turkeys	(5)	[3] 612	518
Beehives	2, 070	2, 194	1, 934

[1] Over 3 months old.
[2] Includes ponies.
[3] Over 4 months old.
[4] Over 6 months old.
[5] Not reported.

FARM POWER AND MECHANICAL EQUIPMENT

The number of horses remained about the same between 1930 and 1950, but the number of mules decreased. Most of the work animals are obtained outside the county, although the number of colts raised has increased in recent years.

Farm equipment varies among the farms. Many of the larger, more productive farms in the county have heavy machinery consisting chiefly of tractors, tractor-drawn tillage implements and grain drills, two-row cultivators, mowing machines, reapers or combines, and corn binders. On the other hand, the smaller, less productive farms, common in the Jefferson-Montevallo and part of the Fullerton-Bolton-Clarksville associations, are equipped only with light one-horse implements and hand tools.

Tillage methods are largely determined by the kind and quality of implements available on each farm, and to some extent by the ease with which the work can be accomplished. Implements vary in type and quality in different localities, although horse-drawn plows, drag harrows, disk harrows, corn planters, riding cultivators, grain drills, hay mowers, and rakes are in general use. Most of the heavier farm machinery—tractors, grain binders, combines, manure spreaders, hay loaders and pick-up hay balers—is used on the farms having relatively smooth and productive soils. On farms having mostly hilly or steep soils, light implements such as hillside plows, bull-tongue plows, and double-shovel cultivators are used. The type of soil is given some consideration in selecting tillage methods and tools. Disk plows are better for some soils than moldboard plows. Most subsoiling is done on the more clayey soils over limestone and on the soils shallow to the kind of shale that is easily disrupted or broken by subsoiling implements.

FARM TENURE

The percentage of farms operated by owners is relatively high. In 1950 owners operated 90.2 percent of the farms, tenants 9.4 percent and managers 0.4 percent. There has been a gradual decrease in tenancy in the last twenty years.

The 1950 census reported 54 cash tenants, 50 cash-share tenants, 121 share tenants, 106 croppers, and 112 other tenants. Rental terms are customarily based upon the assumption that the laborer is entitled to one-third of the crop; whoever supplies the stock and tools, one-third; and the owner of the land, one-third. Croppers who furnish only the labor usually receive one-third of corn and hay crops, but one-half of the vegetables and tobacco. The fertile soils on the river bottoms rent for two-fifths to one-half of the crop. The expense of fertilizer and seed is commonly divided between landlord and tenant in proportion to their share of the crop. Sometimes, however, the landlord furnishes all the seed.

FORESTS [10]

When Knoxville was founded (1791), Knox County was almost entirely occupied by virgin forest. As settlers came in, cutting of the forest increased and lumbering became a large and important industry.

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[10] Prepared by G. B. Shivery, Extension Forester, University of Tennessee.

The junction of the Holston and French Broad Rivers, at the approximate site of Knoxville, was a natural location for sawmills and wood-manufacturing plants. Logs of yellow-poplar, white and red oaks, white ash, basswood, chestnut, sugar maple, black walnut, wild cherry, and white pine were cut far up the tributaries, chained into rafts, and floated down the rivers to the sawmills.

Following 1855, when railroads began to penetrate the Tennessee Valley and establish terminals along the river, rafting was stimulated. Large sawmills were erected, and the lumber was shipped to the north and east. Lumbering in the Tennessee Valley (*10*, *2*, *14*) was most active from about 1890 to the turn of the century, or directly after the virgin pine stands in Michigan and Wisconsin were exhausted.

FOREST RESOURCES

At present 28½ percent of the land area is in forest, and of this 62 percent is in farm woodland and 38 percent in private nonfarm forest (*13*). Based on the number of farms reporting woodland in the 1950 United States census, the average is approximately 18 acres of woodland per farm.

The timber-producing areas are 44 percent upland hardwoods, 49 percent yellow pine-hardwoods, 5 percent cedar-hardwoods, 1 percent oak-chestnut, and 1 percent yellow pine (*12*). Of the total area in forest, 19 percent is classified as saw-timber size, 74 percent as cordwood size, and 7 percent as below cordwood size. The saw-timber volume totals 82,460 M board feet, of which 73,402 M is hardwoods and 9,058 M board feet is softwoods (conifers). The present average volume amounts to 870 board feet an acre, and the total yearly growth is 125 board feet an acre. There are 17 permanent industries using wood, 34 portable mills, 2 cooperage plants, 1 chestnut-extract plant, 1 handle mill, 1 shuttle-block mill, and 2 veneer packaging establishments in the county.[11]

In 1946 the production of lumber amounted to 4,379 M board feet of softwoods (conifers) and 13,833 M board feet of hardwoods. Corresponding figures for 1942, were 1,487 M board feet of softwoods and 5,196 M board feet of hardwoods, respectively. In 1941, 2,200 cords of pine pulpwood, 1,000 cords of hardwood pulpwood, and 3,400 cords of chestnut-extract wood were produced.[12]

FOREST TYPES

In general, each soil association, if still under native forest, supports a dominant forest type. Several of the associations have the same dominant type.

The native forest on the Fullerton-Bolton-Clarksville soil association consists of Southern red, black, and white oaks, yellow-poplar, yellow locust, and less common associates of these trees. These species make up the upland hardwoods forest type and produce timber of high quality.

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[11] 1945–46 Appraisal, State Department of Conservation and the American Forestry Association.

[12] Forest Survey, Appalachian (now Southeastern) Forest Experiment Station.

The yellow pine-hardwoods forest type (25 to 75 percent pines) prevails in a few places. For example, the Muskingum-Lehew soil association supports primarily the yellow pine-hardwoods forest type. Virginia pine is more conspicuous than shortleaf pine in the stand. Hardwoods are mixed with pines on the drier sites—crests of ridges and southern and western exposures. Among these hardwoods are sourwood, scarlet, black, and chestnut oaks, blackgum, and pignut and other hickories. Yellow-poplar, sugar maple, Northern red oak, and white oak are among the better trees on the cooler, more humid sites, as in the ravines and on the north- and east-facing slopes.

The Sequoia-Bland and the Bland-Camp soil associations show a transition from the upland hardwoods forest type to the yellow pine-hardwoods. There are small areas on the more rocky parts occupied by the cedar-hardwoods forest type. The species common in these transitional areas are Southern red oak, blackgum, dogwood, and the hickories. Virginia pine and a smaller percentage of shortleaf pine displace some of the hardwoods in many sections to form the yellow pine-hardwoods forest type. Northern red oak, yellow-poplar, and black walnut predominate on the moist northern and eastern exposures, and chestnut oak, scarlet oak, and sourwood on the dry upper southern and western exposures.

The Armuchee-Leadvale soil association is occupied by the upland hardwoods forest type, and the Dandridge-Litz-Leadvale soil association chiefly by the yellow pine-hardwoods forest type. Shortleaf pine and Virginia pine are both intermixed with the hardwoods in these areas. The cedar-hardwoods forest type occupies the more rocky parts.

The Tellico-Neubert soil association in the southern part of the county has the yellow pine-hardwoods forest type. There are many areas in this association that have been cleared and allowed to revert to forest cover. In these the pines predominate almost to the exclusion of the deciduous trees .

The Stony land-Talbott soil association is occupied largely by the cedar-hardwoods forest type, where redcedar comprises 25 to 75 percent of the dominant stems.

The soils of the Montevallo soil association are very low in fertility and shallow to bedrock, but because of their relatively smooth surface a great part has been cleared for crops. Nearly all of this acreage has been abandoned, but through natural seeding it is now restocked with Virginia pine and some shortleaf pine. There are a few volunteer hardwoods. On much of this association a pure stand of yellow pine will prevail for many years, although in places a stand of yellow pine-hardwoods will develop. Forest does not occupy much of the other associations.

FOREST MANAGEMENT

Good forest management consists of (1) adequate protection from fire, browsing, and other damage; (2) woodland improvement by using defective and low-grade wood for minor uses whenever possible; (3) harvesting practices that will help maintain a stand of the most useful kinds of trees; and (4) establishment of stands where reforestation is desirable. Before much can be accomplished in improving the forests of the county, a greater consciousness of the value of forest

resources and forest improvement must be acquired by the general public and those who manage the forest land.

Fire protection.—Adequate fire protection is probably the most remunerative of the practices required for good management. There is no organized forest fire protection in the county. Everyone should acquaint himself with the damage resulting from forest fires and the precautions to be taken to prevent them. Especial caution is necessary in spring and fall, for in those seasons the forest litter is dry, humidity is low, and winds are strong. Many fires result from carelessness and incendiarism. Range fires are sometimes set intentionally to improve early spring grazing. On many areas of soils poorly suited to either crops or pasture (Fifth-class soils especially), a well established forest cover would be more useful than the limited amount of grazing or of crops now produced.

Control of grazing.—Forest areas materially improve if grazing is controlled. Indiana experiments show that grazing of woodland does not pay. Woodland grazing under intensities of 2, 4, or 6 acres for each animal unit, without supplementary feeding, resulted in serious deterioration of the animals over a 6-month season (*4*). The timber-producing capacity is gradually destroyed by the repeated browsing, and reproduction is prevented. Compaction of the soil, disturbances of humus, and resulting interference with soil porosity lessen water absorption and make growing conditions less favorable.

Selective harvesting.—Selective logging and other good harvesting practices contribute toward the maintenance of a productive stand of useful trees. A radical departure from present harvesting practices is needed to halt the progressive deterioration of forest resources. The existing forest, all of which has been cut over, contains much cull timber. This cull timber should be removed, as it hinders the development of the more desirable trees. Cull trees can be used for pulpwood, fuel, and other minor farm needs.

Reforesting.—Reforestation results from (1) natural revegetation or (2) planting. In locations favorable for seeding, shortleaf pine and Virginia pine generally grow readily. Both display remarkable ability to establish themselves on severely eroded areas. Of the two, Virginia pine is better suited for such sites.

On soils developed over calcareous shale or interbedded limestone and shale, some hardwoods are apt to intermix with pines during natural reforestation. The more common intermixed hardwoods on many forested sites are oaks, hickories, dogwood, blackgum, black locust, persimmon, and sourwood. Redcedar is the most common tree in naturally reforested areas of the limestone rockland, stony land, and gullied land types that consist of Colbert, Talbott, Dandridge, and Armuchee soil materials and is also dominant on the eroded phases of the Colbert, Talbott, Dandridge, and Armuchee soils.

A great many areas of idle land are too far from pine seed trees to become reforested. In these areas, such trees as sassafras and persimmon, as well as briers and other brushy growth, prevail. On such sites and where it is desired to establish a forest cover quickly, planting may be justified. Successful tree planting requires advance preparation, and every location presents a specific problem. Preparation includes such measures as breaking and mulching galled areas, building simple low check dams of brush in gullies, and plowing contour

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furrows. Landowners do the planting, but forest tree seedlings are provided without cost by the Tennessee Valley Authority through the office of the county agricultural agent. A total of 280 acres, involving 108 projects, had been planted in the county through this arrangement at the time of survey.[13] In addition, 310 projects with a total of 2,737 acres, were planted by CCC Camps before 1941. These camps used principally black locust, but some shortleaf pine. Recently the trend has been toward less use of black locust and greater use of shortleaf and loblolly pines.

The species selected for planting should suit the characteristics of the particular soil, such as degree of erosion and kind of exposure. Although farmers many times specify locust for use as fence posts on the farm, pine is usually better suited to the severe growing conditions on lands designated for use as forest.

There are many severely eroded soils and gullied land types that can be most economically reclaimed by planting to forest. Montevallo shaly silt loam, eroded steep phase, and gullied land of Armuchee and Litz, Fullerton and Talbott, Sequoia and Montevallo, Talbert and Decatur, and Tellico and Muskingum soil materials are among those that need replanting. Black locust does well in the well-aerated soil material accumulated behind check dams. A large proportion of the areas need black locust for the silting basins, shortleaf pine on the sheet-eroded areas between gullies, and Virginia pine on the most unfavorable sites. Black locust responds well to cultivation and to fertilization with phosphate fertilizer. In many places these measures are warranted in order to obtain a protective cover quickly.

All other soils of Group 3–A should be reforested unless a very high level of crop or pasture management is practiced. In special cases soils of Groups 2–C and 2–D may likewise be planted profitably to forest tree seedlings. Loblolly pine may be found to be one of the most desirable trees for replanting on these soils where depth of soil, moisture relationship, and protection against ice-glaze are favorable. Shortleaf pine is well suited to most areas of these soils, but Virginia pine should be used on the drier sites, such as south and west exposures where the soil is shallow to bedrock.

INDIRECT BENEFITS OF GOOD FOREST MANAGEMENT

Well maintained forest has important indirect benefits aside from the production of wood products on soils not well suited to more intensive agricultural use. It restrains runoff and improves or maintains favorable soil structure. A well established forest develops a protective layer of litter that absorbs the impact of the falling drops of water and preserves the pores and channels between the soil particles as the water soaks in. Fungi, bacteria, and minute animals that consume the litter and each other produce a dark-brown colloidal substance called humus. When carried downward into the mineral soil by percolating water, the humus improves both physical structure and fertility. This litter and humus has, in addition, great capacity to absorb water directly. Porosity is further achieved by the channels left after the decay of dead roots.

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[13] Information obtained from the Department of Forestry Relations, Tennessee Valley Authority.

The surface roots of trees are highly beneficial in binding soil, and the densest network is found in the lower parts of well-developed layers of litter. Results obtained at the erosion station near Statesville, N. C., show a loss of only 0.002 of a ton of soil and 0.06 percent of rainfall from virgin woods (*3*). A companion woods plot burned twice yearly shows runoff of 11.5 percent and soil loss of 3.08 tons an acre, compared with runoff of 0.06 percent and soil loss of 0.001 ton an acre on an unburned plot. Similar experiments at Zanesville, Ohio, for a 9-year period on cultivated land, pasture, and woodland show the runoff as 20.6 percent, 13.8 percent, 3.2 percent, respectively, and soil loss an acre as 17.18 tons, 0.10 ton, and 0.01 ton (*1*). After some areas of badly deteriorated soils are under a forest cover for a period of years, they may be so rejuvenated that they can again be used, under careful management, for more intensive uses.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of weathering and soil development acting on the parent material deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which that material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the soil material.

Climate and vegetation are active in soil genesis. They act on the parent material accumulated through the weathering of rocks and slowly change it into a natural body with genetically related horizons. The effects of climate and vegetation are conditioned by relief, which influences drainage, the rate of natural erosion, and the kind of vegetation growing on the soil. The nature of the parent material also affects the kind of profile that can be formed and in extreme cases dominates it entirely. Finally, time is needed for the changing of the parent material into a soil profile. It may be much or little, but usually a long time is required for the development of distinct horizons.

The factors of soil formation are so interrelated that the effects of any one are hard to isolate with certainty. It is possible to find some areas where four of the factors are constant or nearly so, and here the effects of the fifth can be partially measured. Even in such places the measurements are approximations of the actual effects. It is convenient to discuss the individual factors and their effects in soil formation, but the reader should remember that it is the integration of these factors, rather than their simple sum, which determines the nature of the soil profile.

The purpose of this section is to present the outstanding morphologic characteristics of the soils of Knox County and show how they are related to the factors of soil formation. Physical and chemical data are limited for these soils, and the discussion of soil genesis and morphology is correspondingly incomplete. The first part of the section deals with the environment under which the soils exist; the second, with specific soil series and the part environment has played in determining the morphologies of soils of those series.

FACTORS OF SOIL FORMATION AS RELATED TO KNOX COUNTY SOILS

The parent materials of the soils of Knox County may be placed in two broad classes: (1) Material residual from the weathering of rocks in place, and (2) materials transported by water or gravity and laid down as unconsolidated deposits of clay, silt, sand, and large rock fragments. Materials of the first class are related directly to the underlying rocks from which they were derived; materials of the second class, to the soils or rocks from which they sloughed or were washed.

The parent materials formed in place consist of the residuum of sedimentary rocks, and the properties of these rocks are strongly reflected in many of the properties of the soils that have developed from them. The sedimentary rocks include limestone, dolomitic and calcic sandstone, and both calcareous and acid shales. Geologically the rocks are old, being of the Cambrian, Ordovician, and Silurian Systems (*9*, *17*). All of the rock formations are folded and faulted and generally have a decided dip.

Certain soils of the county developed from residual materials are generally associated with particular rock formations or parts of rock formations. The Decatur and Dewey soils are chiefly from the weathered materials of high grade dolomites or dolomitic limestones of the Knox dolomite formation. The Clarksville, Bolton, and Fullerton soils are also derived from the residuum of dolomitic limestones of the Knox formation. The Muskingum and Lehew soils are associated with the Rome formation. The Muskingum, on House Mountain, is underlain by Clinch sandstone. Sequoia, Farragut, and Armuchee soils are derived chiefly from the residuum of Sevier and Nolichucky shales. Sequoia soils are also associated with the Athens shale. The Dandridge and Litz soils are from the weathered materials of the Athens and Sevier shales, and the Tellico soils are from Tellico sandstone. The Talbott and Colbert soils are associated chiefly with the Chickamauga formation, and the Bland with the Bays and Moccasin formations. Montevallo soils are chiefly over Rogersville and Nolichucky shales.

Of the soils consisting of general alluvium, the Congaree and Chewacla consist in great part of material originating from slate granite, gneiss, and schist; the Cumberland, Etowah, Huntington, Lindside, Roane, and Melvin apparently contain much material originating from limestone; and the Waynesboro, Nolichucky, Tyler, Wolftever, Sequatchie, Staser, Hamblen, and Prader soils contain material from mixed alluvium originating from shale, limestone, and sandstone.

Of the soils consisting of colluvium and local alluvium, the Emory, Greendale, Camp, Abernathy, Ooltewah, and Guthrie developed from materials orginiating chiefly from limestone; the Jefferson and Cotaco, mainly from acid sandstone and interbedded acid sandstone and shale; the Leadvale and Whitesburg, from shale; and the Alcoa and Neubert, from calcareous sandstone.

Although a rather consistent relationship exists between some soil properties and the kinds of parent materials, other soil properties, especially those of regional significance from the standpoint of soil genesis, cannot be correlated with kinds of parent materials and must be attributed to other factors.

Knox County has a humid temperate climate with long warm summers, short mild winters, and relatively high rainfall. (See section on Climate, p. 7.) The high rainfall throughout the county favors rather intense leaching of soluble and colloidal materials downward in the soil. Since the soil is frozen for only short periods and to only shallow depths, the amount of weathering and translocation of materials is intensified.

The climate is generally uniform, although small local differences exist because of degree of slope and aspect. The influence of any variation in climate is not reflected in the classification of soils into series and types, but local differences in climate may be the cause of some of the local variations in soil types. Climate differences, however, are not great enough to account for the broad differences among the soils.

Trees, shrubs, grasses and other herbaceous plants, micro-organisms, earthworms, and various other forms of plant and animal life live on and in the soil and are active agencies in the soil-forming processes. The nature of the changes that these 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 the associated organisms. The influence of climate is most apparent, though not always most important, as a determinant of the kinds of macroflora that grow on the well-drained, well-developed soils. In this way climate exerts a powerful indirect influence on the morphology of soils.

A mixed hardwood forest, with some pine in places, was on most of the well-drained, well-developed soils. The forests appear to have been relatively uniform over the whole area, and it is doubtful that any of the marked differences in properties of these soils are the direct result of differences in forest cover.

Most of the trees of the natural forest were moderately deep to deep feeders on plant nutrients in the soil and were chiefly deciduous. The leaves of deciduous trees range considerably among species in content of various plant nutrients, but generally they return to the soil somewhat larger amounts of bases and phosphorus than coniferous trees. In this way essential plant nutrients are brought to the upper part of the soil from the lower and in part offset the depleting action of percolating waters.

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. In Knox County such materials decompose rather rapidly as a result 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 to the extent that it does in cooler regions in the mountains to the east.

Little is known of the micro-organisms, earthworms, and other population in the soils of the county. Although this population is important in soil genesis, its effects have not generally been adequately determined.

The well-drained, well-developed soils have been formed under similar climate and vegetation. Climate and vegetation have had maximum influence on these soils, and relief and age have had minimum. As a result the soils developed from various kinds of parent materials have many properties in common.

Under virgin conditions all of the well-drained, well-developed soils have a surface layer of organic debris in varying stages of decomposition. All have dark A_1 horizons. A_2 horizons are lighter in color than either the A_1 or the B. The B horizon is generally uniformly yellowish or reddish and is finer textured than the A_1 or A_2. The C horizon is variable in color and texture among the different soils, but it is usually light red or yellow, mottled or reticulated with gray or brown.

Results of analyses of samples of several comparable soils from Jefferson County, Tenn., may be expected to apply to these soils (*8*). The silica content decreased and the alumina and iron contents increased with depth. The content of organic matter was moderate in the A_1 horizon, 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, and the loss from ignition was generally low, indicating a low content of very tightly held water. The soils were medium, strongly, or very strongly acid throughout the solums. In general the amount of silt decreased and the amounts 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. Clay minerals in the profile include all three major types, but the kaolinite group is thought to be the most important.

The properties just mentioned are common to all well-developed, well-drained soils that have been subjected to similar conditions of climate and vegetation. They are, therefore, common to soils of zonal extent, and all soils that exhibit them can be called zonal soils. Zonal soils (*16*) are members of one of the classes of the highest category in soil classification and 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. In areas in this county 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 areas where the parent materials have been in place only a short time, as those recently transported, most of 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 therefore called azonal soils. Azonal soils (*16*) are members of a second class of the highest category of soil classification and are defined as a group of soils that do not have well developed soil characteristics, either because of their youth or because of conditions of parent material or relief that prevent normal profile development.

The azonal soils have the following characteristics: (1) Moderately dark A_1 horizons with apparently a moderately to fairly high content of organic matter; (2) absence of a zone of illuviation, or B horizon; and (3) parent material usually lighter than the A_1 horizon in color and similar to, lighter than, or heavier than the A_1 horizon in texture.

They may be referred to as A–C soils because of the absence of a B horizon.

On some steep areas where the water percolation is slow, and the volume and rapidity 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 A–C soils. These soils are also azonal soils.

On some nearly level areas where both internal drainage and surface runoff are slow 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 (*16*). They 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 climate and vegetation. The properties of such soils in this area are generally the result of level relief influenced greatly by the character of the parent material. These soils are of very small extent.

Soils of each of the three orders, zonal, azonal, and intrazonal, may be derived from similar kinds of parent materials. Within any one of those orders in this area, major differences among soils appear to be closely related to differences in the kinds of parent materials. The thickness of soils developed from residual materials over the rock from which they were derived is a partial function 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 that grow on the soil.

Rocks have also contributed to differences among soils through their effects on relief. The rocks of most of this county are of old formations that are folded and faulted. The present relief is probably largely a product of geologic weathering and erosion of those formations; the higher lands are capped by more resistant rocks, whereas the valleys are underlain by the less resistant rocks (*17*).

The internal drainage of soils of nearly level relief in the limestone areas is exceptionally good in most areas as a result of good subterranean drainage through caverns and crevices in the sharply dipping rocks. This subterranean drainage in the areas underlain by limestone counteracts the usual effects of gentle relief on drainage. It also allows parent rock to be the main cause of local differences among the well-developed, well-drained soils derived from residual materials—soils that are subject to similar forces of climate and vegetation in this area.

CLASSIFICATION OF SOILS

The soils of Knox County are classified in table 7. The order, the great soil groups under each order, and the various soil series under each great soil group are given. The source and kinds of parent materials and the relief and age of each soil are shown. Study of this table will enable the reader to understand more easily the genetic relationships of the soils of the area.

Following the table, the morphology of representative soils of each great soil group is described and discussed in detail.

TABLE 7.—*Soil series of Knox County, Tenn., classified by soil orders and great soil groups, and factors that have contributed to differences in soil morphology* [1]

ZONAL

Great soil group and series	Relief	Parent material	Time [2]
Red-Yellow Podzolic:			
Red members:		Residium weathered from—	
Decatur	Undulating to hilly	High grade limestone	Long.
Dewey	Undulating to steep	do	Do.
Bolton	Rolling to steep	Arenaceous limestone or limestone with sandy beds.	Do.
Fullerton	Undulating to steep	Moderately cherty limestone	Do.
Talbott	Undulating to hilly	Moderately argillaceous limestone	Do.
Farragut	do	High grade limestone over shale	Do.
Sequoia [3]	do	Interbedded shale and limestone and calcareous shale.	Do.
		Mixed general alluvium strongly influenced by—	
Cumberland	do	Limestone	Do.
Etowah	do	do	Medium.
Waynesboro	do	Shale, sandstone, and limestone	Long.
Nolichucky	Rolling	do	Do.
		Local alluvium chiefly from—	
Alcoa	Undulating to rolling	Tellico soils	Medium to long.
		Residuum weathered from—	
Bland [4]	Rolling to steep	Dusky-red shaly limestone	Short to long.
Tellico [4]	do	Calcareous sandstone	Do.
Yellow members:			
Clarksville	do	Cherty limestone	Long.
		Mixed general alluvium derived largely from—	
Sequatchie	Undulating to rolling	Sandy rocks	Medium.
		Colluvium and local alluvium chiefly from—	
Jefferson	do	Muskingum and Lehew soils	Medium to long.
Leadvale	do	Dandridge, Armuchee, Sequoia, Litz, Montevallo, Muskingum, and Lehew soils.	Long.
		Residuum weathered from—	
Colbert [4]	Undulating to hilly	Argillaceous limestone	Short to long.

INTRAZONAL

Planosols:		Mixed alluvium strongly influenced by—	
Wolftever	Undulating to rolling	Limestone, shale, and sandstone	Long.
Guthrie [5]	Nearly level	Chiefly limestone	Very long.
Tyler	do	Chiefly shale	Do.

AZONAL

Alluvial soils:		General alluvium strongly influenced by—	
Huntington	Nearly level	High grade limestone	Very short.
Roane	do	Cherty limestone	Do.
Lindside	do	Limestone	Do.
Congaree	Nearly level to very gently undulating.	Micaceous rocks	Do.
Chewacla	Nearly level	do	Do.
Staser	Nearly level to very gently undulating.	Chiefly shale	Do.
Hamblen	Nearly level	do	Do.
		Local alluvium chiefly from—	
Emory	Undulating to rolling	Decatur, Dewey, and Farragut soils	Very short to long.
Greendale	do	Fullerton and Clarksville soils	Do.
Camp	Gently sloping to sloping	Bland soils	Do.
Abernathy	Nearly level	Chiefly Decatur, Dewey, and Farragut soils	Very short.
Ooltewah	do	do	Do.
Whitesburg	Undulating to rolling	Dandridge, Armuchee, Litz, and Sequoia soils.	Do.
Cotaco	do	Muskingum, Lehew, and Jefferson soils	Do.
Neubert	do	Tellico soils	Do.
Melvin [6]	Nearly level	Limestone	Short.
Prader [6]	do	Shale	Do.

See footnotes at end of table.

TABLE 7.—*Soil series of Knox County, Tenn., classified by soil orders and great soil groups, and factors that have contributed to differences in soil morphology* [1]—Continued

AZONAL—Continued

Great soil group and series	Relief	Parent material	Time [2]
Lithosols:			
		Residium weathered from—	
Armuchee	Hilly to steep	Interbedded limestone and shale	Medium to very short.
Dandridge	do	Calcareous shale	Do.
Litz	do	Leached shale	Do.
Montevallo	Undulating to steep	Acid shale	Short to very short.
Muskingum	Hilly to steep	Chiefly sandstone	Medium to very short.
Lehew	do	Dusky-red sandy shale	Do.

[1] Inasmuch as climate and vegetation are relatively uniform over the county, they cannot account for the broad differences in the soils.

[2] The length of time that the material has been in place as indicated by the degree of profile development.

[3] The Sequoia profile is partly within the range of the Red members and partly within that of the Yellow members.

[4] These soils are relatively shallow to bedrock, have weakly differentiated or thin B horizons, and are considered, therefore, to be intermediate between zonal soils and the azonal Lithosols. They are frequently described as being lithosolic.

[5] Some of the Guthrie soil as mapped in Knox County classifies as alluvial soil with gley horizon.

[6] These soils have gley horizons. Under recent refinements in classification, they would be classed as Low Humic Gley soils.

MORPHOLOGY OF SOILS REPRESENTING THE GREAT SOIL GROUPS

RED-YELLOW PODZOLIC SOILS

RED MEMBERS

The red members of the Red-Yellow Podzolic great soil group (*16*) are zonal soils having thin organic and organic-mineral layers over a yellowish-brown leached layer which rests upon an illuvial red horizon. They developed under a deciduous or mixed forest in a warm-temperate moist climate. The soil-forming processes involved in their development are laterization and podzolization. The red members in Knox County are listed in table 7.

These soils apparently have all developed under relatively similar conditions of climate and vegetation. They are well drained, and although they range somewhat in degree of maturity, all are old enough to have at least a moderately well developed Red-Yellow Podzolic soil profile. They range from undulating to steep. Profile differences are probably not caused primarily by variance in slope gradient. Many profile differences can be correlated with marked differences among parent materials.

Decatur series

The soils of the Decatur series have thick solums and have developed from high grade limestone on undulating to steep areas in the uplands. They have few rock outcrops except in severely eroded places. Since they are among the most productive and well-developed soils in the county, they probably supported some of the most luxuriant vegetation. As a natural result they have a darker A horizon than any of the other well-developed soils—an indication of a higher content of organic matter. The luxuriant vegetative growth also tended to inhibit erosion and to develop a friable surface soil and subsoil.

A typical Decatur profile follows:

A_2 0 to 12 inches, dark-brown to dark reddish-brown (7.5YR 3/2 to 5YR 3/2)[14] friable heavy silt loam with a moderately well-developed medium crumb structure.

B_1 10 to 18 inches, yellowish-red (5YR 4/6) to reddish-brown friable silty clay loam with a weakly developed fine to medium blocky structure.

B_2 18 to 42 inches, red (2.5YR 4/6) or dark-red plastic silty clay with a well-developed medium to coarse blocky structure; structure faces glossy and darker than the crushed material; many dark-gray to black concretions, usually less than one-fourth inch in diameter.

B_3 42 to 70 inches, reddish-brown or yellowish-red firm to plastic silty clay; structural particles larger and less distinct than in layer above; a few weathered, soft, powdery chert fragments.

C 70 to 90 inches +, reddish-brown or yellowish-brown firm to plastic silty clay or clay lightly splotched and streaked with red, brown, yellow, and gray; bedrock at 12 to 30 feet in most places.

Dewey series

The soils of the Dewey series developed from high grade limestone, apparently higher in insoluble impurities, particularly silica, than the rocks underlying the Decatur soils. They are generally somewhat

[14] Soil color names are those adopted by the 1948 Committee; symbols following names are Munsell color notations.

thicker over bedrock than the Decatur, lighter red throughout the profile, less fertile, and in many places slightly stronger in relief. Their natural vegetation, especially the ground cover, probably was slightly less dense than on the Decatur soils.

Dewey soils are moderately subject to erosion when cultivated and many have a truncated profile as a result. They are more erosive than the Fullerton and less erosive than the Decatur soils on similar slopes, are medium to strongly acid, and are generally less well supplied with bases than the Decatur soils but better supplied than the Fullerton. It is probable that the major differences among the three series are directly or indirectly the result of differences in parent materials.

The following is a typical profile of Dewey silt loam:

A_1 0 to 2 inches, dark-brown or dark grayish-brown mellow very friable silt loam that has a soft fine crumb to medium crumb structure; high in organic matter.

A_2 2 to 10 inches, grayish-brown to dark-brown (7.5YR 3/2) friable silt loam; moderately well developed crumb structure.

B_1 10 to 16 inches, reddish-brown (5YR 4/4) to yellowish-red moderately friable heavy silty clay loam; moderately well developed coarse granular to fine blocky structure; many small round brownish-black concretions.

B_2 16 to 44 inches, red to yellowish-red (5YR 4/6) firm moderately plastic silty clay with a moderately well developed blocky structure; a few small concretions and small chert fragments.

B_3 44 to 60 inches, red to yellowish-red (5YR 5/8) plastic silty clay or clay; structure particles larger but somewhat less distinct than in layer above; chert fragments more common and less completely weathered.

C 60 to 100 inches, red or yellowish-red firm to moderately plastic silty clay or clay streaked and splotched with yellow, red, and some gray; considerably more chert fragments than in other horizons; bedrock at depths of 15 to 30 feet in most places.

Bolton series

Bolton soils developed from materials residual from sandy (arenaceous) limestone or from limestone with sandy interbeds. They occur on the cherty ridges in association with Fullerton soils in the zone transitional from Gray-Brown Podzolic to Red-Yellow Podzolic regions. A great part of their acreage is on the rolling to steep north- and east-facing higher parts of the ridge slopes. The soils are characterized by a decidedly dark-brown surface layer that has a spongy feel under pressure. Farmers speak of the plow layer of the less eroded parts as "push" soil, as the material commonly does not readily scour from the plow. These soils are well drained, medium to strongly acid, and relatively high in organic matter. Vesicular dark-brown sandstonelike fragments are common, and there is generally a small amount of chert. The color profile resembles that of the Dewey and Decatur soils. The chief distinguishing difference is the more permeable and friable solum.

The following is a typical profile of Bolton silt loam:

0 to 7 inches, dark-brown to dark reddish-brown mellow spongy loam to silt loam; where not appreciably eroded, this layer is 8 to 12 inches thick and lighter brown (5YR 3/3) in places; under virgin conditions ½ to 2 inches of acid forest litter is on the surface.

7 to 16 inches, dark reddish-brown (5YR 3/4) friable silty clay loam.

16 to 40 inches, reddish-brown firm but notably friable silty clay.

40 inches +, red to dark-red (2.5YR 3/6) firm but friable silty clay with faint gray, yellow, and brown mottles; bedrock at depths of 15 to 30 feet.

Fullerton series

Fullerton soils developed from residuum derived chiefly from dolomite or dolomitic limestone high in insoluble materials, chiefly silica. The silica is largely in the form of chert, but locally calcareous sandstone beds have contributed to the parent materials. These soils commonly occupy higher positions than the Dewey and Decatur soils; are deeper to bedrock, less fertile, less erosive, and more cherty; and have steeper slopes and a greater amount of insoluble parent material.

As a result of their lower susceptibility to erosion and greater volume of weathered residue, the Fullerton soils have a thicker mantle of unconsolidated rock material over bedrock than the Dewey and Decatur soils. This mantle, which probably protects the bedrock from rapid weathering, together with the fact that their cherty dolomite weathers more slowly than high grade limestone or dolomitic limestone, may largely account for the higher position and steeper slopes of these soils. The Fullerton soils are medium to strongly acid throughout the profile.

Following is a description of a typical profile of Fullerton silt loam:

A_1 0 to 2 inches, dark-gray or dark grayish-brown (10YR 4/2) silt loam stained dark with organic matter.

A_2 2 to 8 inches, brownish-gray, very pale-brown (10YR 8/4 to 7/4, dry), or light yellowish-brown (10YR 6/4, moist) very friable silt loam.

A_3 8 to 14 inches, reddish-yellow (7.5YR 7/6, dry) or yellowish-red (5YR 5/8, moist) friable heavy silt loam with a weak soft medium crumb structure.

B_1 14 to 22 inches, reddish-yellow (5YR 6/8, dry) or red (2.5YR 5/8, moist) friable silty clay loam with a weak medium blocky structure.

B_2 22 to 40 inches, reddish-yellow to red (2.5YR 5/6, dry; 2.5YR 4/6, moist) slightly plastic to plastic silty clay with a well-developed medium nut structure.

C 40 to 60 inches +, reddish-yellow to red plastic silty clay streaked or reticulated with gray and brown; a few chert fragments throughout the soil, the quantity increasing with depth; bedrock at depths of 20 to 40 feet.

Talbott series

The Talbott soils have the heavy-textured B and C horizons characteristic of soils having parent materials derived from argillaceous limestone. They are thinner over bedrock than the Fullerton and Dewey soils; and their position, relief, and thickness suggest that the parent limestone weathers rapidly and leaves a relatively small quantity of insoluble residue. They are eroded readily when cultivated and may have been eroded rather rapidly under natural vegetation. This erosion probably accounts in part for their thinness over bedrock. The soils are medium to strongly acid throughout the profile.

A representative profile of Talbott soil (silt loam) is as follows:

0 to 8 inches, dark reddish-brown (5YR 3/4) silt loam; under virgin conditions ½ to 1 inch of forest litter on the surface overlies 1½ to 2 inches of dark-brown weakly granular mellow silt loam.

8 to 20 inches, red (2.5YR 4/8) or yellowish-red (5YR 5/8) very firm plastic silty clay.

20 inches +, yellowish-red very firm plastic silty clay with yellow and gray mottles; some areas free of the mottles; argillaceous limestone bedrock generally at depths of 2 to 6 feet but is shallower in some places and outcrops in others.

Farragut series

The Farragut soils have developed from materials weathered from a thin bed of limestone over shale. The parent materials differ from those of Sequoia soils in having a higher proportion of limestone, and from the Decatur soils in having a shaly substratum at depths ranging from 18 to 48 inches. Farragut soils essentially consist of a shallow Decaturlike solum resting on disintegrated acid shale. They occupy valley positions similar to those of the Decatur and many areas of the Sequoia soils. They are fertile and medium to strongly acid. The predominant slope range is undulating to rolling. The native vegetation was predominantly oaks, hickories, and associated deciduous hardwoods.

A representative profile of Farragut soil (silt loam) is as follows:

0 to 8 inches, brown (7.5YR 4/2, dry) or dark reddish-brown (5YR 3/3, moist) friable silt loam; lower part may be lighter brown and finer textured; under virgin conditions layers may be 10 to 12 inches thick, with the surface 2 inches darker and of higher organic content.

8 to 12 inches, gradation from brown to reddish-brown friable silty clay loam; moderately developed firm blocky structure.

12 to 20 inches, reddish-brown (5YR 4/4 to 4/6) firm plastic silty clay; in places may be more nearly yellowish brown.

20 to 40 inches, yellowish-brown to yellowish-red (5YR 4/8 to 7.5YR 5/8) firm plastic silty clay with some reddish and gray mottles and some dark concretions; lighter brown with depth; thickness varies greatly; underlying soft variegated brownish-yellow and gray shaly material is at depths ranging from 18 to 48 inches.

Sequoia series

The Sequoia soils have developed from the weathered products of interbedded shale and limestone and from calcareous shale. The parent material contains less limestone than that of the Farragut soils but more than that of the Montevallo and Litz soils. This difference in parent material is apparently the cause of the differences among these series. The Sequoia soils have parent material similar to that of the Armuchee soils, but differ from them in occupying milder relief and are therefore subject to slower geologic erosion. As a result they have developed zonal profiles, whereas the Armuchee soils have developed only azonal profiles.

The Sequoia soils, compared with soils such as the Fullerton, Clarksville and Dewey, are shallow to bedrock but have relatively strong textural and structural zonal profile characteristics. That is, the illuviated layer of the Sequoia has a decidedly finer texture and a relatively strong moderate blocky structure in contrast to the silt loam texture and weak crumb or granular structure of the eluviated layer. The Sequoia soils are moderate in fertility, moderately well drained internally, and medium to strongly acid.

A representative profile of a Sequoia silt loam follows:

0 to 8 inches, very pale-brown (dry) or light yellowish-brown to yellow (moist) friable silt loam with a weak fine granular structure; under virgin conditions surface inch darker (10 YR 6/4 to 7/6).

8 to 14 inches, reddish-yellow (7.5YR 6/8) firm silty clay loam with moderate to well-developed blocky structure.

14 to 22 inches, reddish-yellow (7.5YR 5/8) to strong brown very firm plastic somewhat waxy (compact when dry) silty clay that has a moderate to well-developed medium blocky structure; may contain small dark concretions and in the lower part some partially weathered shale fragments.

22 inches +, mottled yellow, red, and gray very firm plastic silty clay.

Shale is at depths of 18 to 42 inches. In many places, to a depth of several feet, it is soft, evidently leached, calcareous shale. In other places calcareous shale is within 6 or 8 inches of the lower edge of the solum. In some landscapes there are limestone interbeds in the shale.

Cumberland series

The Cumberland soils are well developed red members of the Red-Yellow Podzolic soils. They formed from high-lying very old deposits of mixed alluvium strongly influenced by limestone. The predominate slope is undulating to rolling, although an appreciable part is hilly. The relatively high fertility of these soils, together with favorable moisture conditions, appears to have supported a heavy forest growth that left a relatively high content of organic matter in the upper layer. The Cumberland resemble the Decatur soils in many properties but are generally deeper and more friable and have some cobbles and pebbles in the profile. Commonly an irregular gravelly bed is directly above the underlying sedentary material. These soils are medium to strongly acid throughout.

A representative profile follows:

0 to 8 inches, brown (7.5YR 5/4 to 4/4) mellow silt loam; under virgin conditions has a thickness of 12 inches, a decidedly darker surface 2 inches, and much organic matter.

8 to 16 inches, yellowish-red (5YR 4/8) friable silty clay loam.

16 to 40 inches, red to dark-red (2.5YR 4/6 to 3/6) firm but somewhat friable silty clay with a weakly developed medium blocky structure.

40 inches +, yellowish-red firm but moderately friable silty clay or silty clay loam that may have yellow and gray reticulations.

A small quantity of quartzite pebbles occurs throughout the soil, and in places quartzite cobbles are abundant. In many places a gravelly bed, varying in thickness and amount and size of gravel, is below this layer. The sedentary, or underlying, bedrock is at depths of 4 to 20 feet. In general the shallower depths to bedrock occur on the more sloping parts.

Etowah series

The soils of the Etowah series consist of materials comparable to those of the Cumberland soils. The chief difference is that the Etowah soils are somewhat younger in profile development. They are generally on lower stream terraces and have a smoother relief, a lighter red color throughout the profile, and a more friable subsoil. Areas of Etowah and Cumberland soils along the French Broad River contain a noticeable amount of mica, which indicates an admixture of material from micaceous rock.

Representative profile:

0 to 7 inches, grayish-brown to dark grayish-brown (10YR 5/2 to 4/2) silt loam; under virgin conditions the surface 1 to 2 inches is dark brown.

7 to 30 inches, strong brown (7.5YR 5/6 to 5/8), approaching yellowish-red, friable silty clay loam of weak nut structure.

30 inches +, strong-brown friable silty clay loam with faint gray mottlings; limestone or shale bedrock at depths of 6 to 40 feet; gravel and cobbles not so common as in the Cumberland, Waynesboro, and Nolichucky soils.

Waynesboro Series

These Red members of the Red-Yellow Podzolic group developed on old high-lying deposits of mixed alluvium. Like the Cumberland, the Waynesboro soils have red subsoil and are well drained. They have, however, a somewhat lighter brown surface (or eluviated) layer, a less uniformly red subsoil, and a greater quantity of sand throughout the solum. The Waynesboro soils are less influenced by limestone than the Cumberland and lower in fertility, and their reaction is medium to strongly acid. The slope ranges from undulating to hilly.

Representative profile:

0 to 1 inch, very dark grayish-brown (10YR 3/2 to 2/2) loam.
1 to 4 inches, dark grayish-brown (10YR 4/2) loam.
4 to 9 inches, brown (7.5YR 4/4) loam.
9 to 18 inches, strong-brown (7.5YR 5/8) firm but friable silty clay loam with a moderate to weak blocky structure.
18 to 36 inches, red firm but friable silty clay loam with a moderate blocky structure.
36 inches +, yellowish-red (2.5YR 4/8), reticulated with yellow and gray, firm but friable clay loam.

In many places an irregular gravelly bed follows the last layer of the profile just described and limestone or shale bedrock is at depths of 3 to 40 feet. The shallower areas are on the strongest slopes.

Nolichucky series

Like the Waynesboro, the Nolichucky soils developed on old high-lying deposits of mixed alluvium. They differ from the Waynesboro chiefly in having a grayer surface soil and a lighter red subsoil. They are undulating to hilly, have good internal drainage, and are moderately low in fertility. They are highly leached and consistently strongly acid.

Representative profile:

0 to ½ inch, dark-gray loam containing abundant partly disintegrated organic matter.
½ to 8 inches, very pale-brown (10YR 7/4, dry) or light yellowish-brown to yellowish-brown (10YR 6/4 to 5/6, moist) loam.
8 to 20 inches, yellowish-red to red (2.5YR 4/8) moderately friable clay loam with a moderate medium blocky structure; much of this layer more nearly reddish yellow.
20 to 40 inches, red to light-red (2.5 YR 5/8 to 6/8) firm clay loam to sandy clay.
40 inches +, reddish-yellow firm sandy clay loam reticulated with yellow and gray.

An irregular gravel bed is generally at a depth of 5 feet or more, and a few cobbles and pieces of gravel are common to the entire profile.

Alcoa series

The Alcoa soil developed on old colluvium or old local alluvium derived from Tellico soils. The surface layer is dark and relatively high in organic matter. The profile is well drained and moderately permeable. The soil is undulating to rolling and mostly on mod-

erately smooth foot slopes below ridges of Tellico soils but above the strips of Neubert soils along the drainageways. This is a fertile soil, medium to strongly acid.

Following is a description of a typical profile:

0 to 2 inches, dark-brown (7.5YR 3/2) friable silt loam.
2 to 10 inches, brown (dry) or reddish-brown (5YR 4/3, moist) mellow silt loam.
10 to 16 inches, yellowish-red (5YR 4/8) friable silty clay loam with a fine, weakly developed, blocky structure.
16 to 36 inches, yellowish-red (5YR 5/8) moderately firm silty clay loam with a medium, moderately developed, blocky structure.

Sedentary shaly material is at depths of 3 to 12 feet.

Bland series

The soils of the Bland series developed from residuum derived from dusky-red shaly limestone. The parent rock has a high content of clay. The thickness of the soils is not great; it exceeds 40 inches in a few places. The range of profile development is broad within this series. On the smoothest parts, the profile is at least moderately well developed, as indicated by the structure of the B layer, or subsoil. On the strong slopes, the soil is shallow to bedrock and the profile is decidedly lithosolic. The entire profile is dark, reddish, and high in clay. The reaction in most places ranges from slightly to medium acid.

Following is a description of a profile taken where the surface is undulating to rolling:

0 to 3 inches, weak-red (2.5YR 4/2, dry) or dusky-red (10R 3/2, moist) heavy silt loam to silty clay loam; in virgin areas a darker surface inch and a notable amount of partly disintegrated organic matter; in some virgin areas this darker layer is 5 or 6 inches thick.
3 to 10 inches, weak-red (10R 4/3, dry) or reddish-brown (2.5YR 4/4, dry) to dusky-red or dark-red (10R 3/3 to 4/3, moist) silty clay that is soapy and moderately plastic when wet; fine to medium, moderately developed, blocky structure.
10 to 20 inches, weak-red (2.5YR 5/2, dry) or dusky-red to dark-red (10R 3/3 to 3/4, moist) silty clay with a somewhat coarser structure in the lower part; dusky-red limestone bedrock below this layer.

Tellico series

Tellico soils have developed over calcareous sandstone and occupy, for the most part, a hilly to steep landscape. Only a small part is undulating to rolling, and these smoother areas are on ridge tops and have thicker more mature profiles than the steeper ones. On the strongest slopes, bedrock is at shallow depths and the profile is more nearly lithosolic in most places. Tellico soils are reddish, friable, and well drained; their reaction is medium to strongly acid.

Profile description for Tellico loam in a smooth area:

0 to 2 inches, grayish-brown (10YR 5/2, dry) or very dark grayish-brown (10YR 3/2, moist) loam containing much partly disintegrated organic matter.
2 to 11 inches, light-brown (7.5YR 6/4, dry) or reddish-brown (5YR 4/4, moist) friable loam; in many places the 11-inch surface layer (this layer and the one above) is fine sandy loam with a more reddish cast.
11 to 16 inches, light reddish-brown (5YR 6/4, dry) or reddish-brown (2.5YR 4/4, moist) friable fine sandy clay loam with a fine, weakly developed, blocky structure.

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16 to 30 inches, red (2.5YR 4/6, dry) or dark-red (2.5YR 3/6, moist) friable clay loam or sandy clay loam with a medium, moderately developed, blocky structure; firm when dry.

30 inches +, predominantly reddish brown friable fine sandy loam or clay loam with streaks and splotches of yellow and brown; material becomes looser and more sandy with depth and in places is nearly free of sand; in some areas the underlying material is hard grayish or pinkish calcareous sandstone that has the appearance of limestone, in others it is soft laminated brown, yellow, and very dark-olive sandy shalelike residuum.

YELLOW MEMBERS

The yellow members of the Red-Yellow Podzolic great soil group (*16*) are zonal soils having thin organic and organic-mineral layers over a grayish-yellow leached layer that rests on a yellowish horizon. These soils in Knox County (see table 7) have undulating to steep relief and were developed under a forest vegetation that consisted mainly of deciduous trees with an admixture of pines in places. There may have been more pines and a somewhat less luxuriant and different kind of undergrowth on the yellow members than on the red members of the Red-Yellow Podzolic soils of the area. The degree to which there was uniformity in such a relationship is unknown. Climatic conditions for soils of the two groups were apparently similar.

The causes for development of pronounced color differences between the yellow and the red members are not known. It appears, however, that the yellow members of the county generally have parent materials either lower in bases or less well drained internally than the parent materials of the red members. The parent materials for the yellow members were derived from cherty limestone, interbedded limestone and shale, pure shale, and old alluvium.

Clarksville series

The Clarksville soils developed from cherty dolomitic limestone. They are noted for their chertiness, light-gray surface layer, yellowish subsoil, and great depth to bedrock. Internal drainage is moderate, and the content of organic matter and plant nutrients usually is notably low. There is some evidence that Clarksville soils do not hold plant nutrients so well as the Decatur, Dewey, and other red members. The Clarksville soils developed on undulating to steep relief, and relatively young profiles on steeper relief are included in the mapping. The reaction of the soils is strongly acid.

A representative profile:

0 to 8 inches, pale-yellow or virtually gray (dry) or light yellowish-brown (10YR 6/4, moist) cherty silt loam; virgin areas have a thin layer containing partly disintegrated organic matter.

8 to 20 inches, pale-yellow (2.5Y 7/4) cherty silt loam.

20 to 50 inches, strong-brown (7.5YR 5/8) or brownish-yellow (with some yellow and gray splotches in the lower part) firm cherty silty clay loam or cherty silty clay.

50 inches +, variegated or reticulated reddish-yellow, yellow, and gray firm to very firm cherty silty clay; cherty dolomitic limestone bedrock at depths of 20 to 40 feet.

Sequatchie series

The Sequatchie soil developed on low stream terraces consisting of mixed general alluvium that contains a notable amount of sandy ma-

terial. The profile is much less strongly developed than that of many other zonal soils. Most areas lie approximately 15 feet above the adjoining bottoms and have an undulating or gently billowy surface. The soil is well drained, medium acid in most places, permeable, and of moderate fertility. It has a moderate content of organic matter.

Description of a typical profile:

0 to 10 inches, pale-brown (dry) or brown (10YR 4/3, moist), friable fine sandy loam.

10 to 18 inches, yellowish-brown (dry) or brown (7.5YR 4/4, moist) moderately firm fine sandy clay loam with a medium, moderate to weak, nut structure.

18 to 30 inches, brownish-yellow to yellowish-brown (dry) or strong brown (moist) moderately firm fine sandy clay loam with a moderately developed nut structure; material variable below this depth—in some places grades to lighter colored more sandy material, in others to finer textured material with occasional mottles.

Jefferson series

Jefferson soils occur on gently sloping foot slopes below the steep ridges of Muskingum and Lehew soils. They developed on old colluvium or local alluvium from these soils. Most areas have well-developed zonal profiles. Nevertheless, the underlying sedentary shale beds are in many places at such shallow depth as to cause the Jefferson solum to be thin. The content of organic matter is low, and the general level of fertility is not high. The reaction is medium to strongly acid. The solum is permeable, but the underlying shale interferes somewhat with percolation of moisture.

Description of a representative profile:

0 to 8 inches, yellowish-gray or very pale-brown (dry) or pale-brown (10YR 6/3, moist) loam; in virgin areas the surface inch is dark gray (10YR 4/1) and contains much partly disintegrated organic matter.

8 to 22 inches, brownish-yellow (10YR 6/6, dry) or yellow friable fine sandy clay loam with a medium, moderately developed, nut structure.

22 to 36 inches, mottled or reticulated yellow, strong-brown, and gray moderately firm but friable clay loam; mottles weak in the upper part but strong in the lower; shale bedrock at depths of 2 to 12 feet.

There are some pebbles and sandstone fragments in the profile and on the surface in places.

Leadvale series

The Leadvale soils have developed on moderately old to old local alluvium that came chiefly from soils developed over shales. They are closely associated with Cotaco and Whitesburg soils and are mapped with them in undifferentiated units. The Leadvale soils have shale within a depth of 4 to 8 feet in most places, although it may be as deep as 15 feet. Internal drainage is moderately slow, as indicated by the predominantly mottled condition below a depth of about 24 inches. The soils generally are low in organic matter and plant nutrients; they are medium to strongly acid even in the areas where the parent alluvium was derived from calcareous shale. The Leadvale solum is well developed, and in many places the mottled layer may be sufficiently compact to allow classifying Leadvale soil as a Planosol.

Representative profile:

0 to 8 inches, light-gray, light brownish-gray, or very pale-brown silt loam; in virgin areas surface inch or so has a notable amount of partly disintegrated organic matter.

8 to 24 inches, yellow firm silty clay loam with a moderately developed medium blocky structure.

24 inches +, mottled yellow and gray firm but somewhat friable silty clay loam; in most places breaks to moderate-sized, fairly hard fragments when dry; in places fragments are small and break from each other easily.

Colbert series

The Colbert soils have heavy sticky plastic yellowish subsoils and are shallow to argillaceous limestone bedrock. The extremely heavy clayey parent material apparently is the result of a very slow accumulation of residuum from a rather pure carbonate rock. Its base-exchange capacity is high, and the percolation of moisture through it is very slow. These characteristics, causing slow leaching or removal of soluble materials by percolation and rapid geologic erosion, have greatly retarded or postponed the development of a zonal profile. The smoother areas where accelerated erosion has not been very active have a moderately developed zonal profile, but the more sloping parts have only a weakly developed one. It is for this reason that the soils of the Colbert series are frequently described as lithosolic Red-Yellow Podzolic soils.

Following is a description of a typical profile of a Colbert soil taken from a smooth area:

0 to 6 inches, light-gray (2.5Y 7/2, dry) or light brownish-gray (2.5Y 6/2, moist) friable silty clay loam; in many places material is darker, ranging to grayish brown when moist; under virgin conditions a notable amount of partly disintegrated organic matter is in the surface inch.

6 to 14 inches, pale-yellow (2.5Y 8/4, dry) or yellow (2.5Y 7/6, moist) firm moderately plastic silty clay that breaks to medium-sized, moderately developed, blocky fragments.

14 to 30 inches, yellow (2.5Y 8/6 to 8/8, dry) or brownish-yellow (10YR 6/8, moist) very firm plastic clay with some strong brown and gray mottles; massive when dry and breaks from place in rather large hard angular pieces; bedrock at depths of 1 to 3 feet.

PLANOSOLS

The Planosol great soil group (*16*) is an intrazonal group of soils with eluviated surface horizons underlain by horizons more strongly illuviated, cemented, or compacted than those of the associated soils. These developed upon nearly level upland surfaces under grass or forest vegetation in a humid or subhumid climate. In this county Planosols (see table 7) have nearly level or slightly depressed relief and are poorly or imperfectly drained. Their illuviated layers are more dense or compact than those of the zonal soils, but the degree of development of these layers varies.

Climatic conditions were similar to those under which the zonal soils developed, but on the whole the Planosols are moister and less well aerated. Some difference probably exists between the kinds of vegetation on the Planosols and Red-Yellow Podzolic soils, although the extent or the effect of such differences is not known. Most of the Planosols appear to be older in profile development than the Red-

Yellow Podzolic soils, since they have more leached, or lighter colored, surface layers and more compact subsoils. The relief of these Planosols is such that geologic erosion has been slow, but that factor alone is not the cause of their formation. The soil material itself is not older than that of associated zonal soils having similar relief. It is possible that relatively dense layers in the parent material or a high water table has caused slow internal drainage. This combined with slow surface runoff and unusual siltiness of the parent material resulted in the development of an abnormally heavy or compact subsoil.

Wolftever series

The Wolftever soils are on low stream terraces consisting of mixed alluvium. They have an undulating to rolling relief. Surface runoff is fairly good in most areas, but internal drainage is impeded by the compact subsoil and substratum. The parent material does not differ greatly from that of the Etowah series, but the soil is moister and aeration is lower. The natural fertility is moderate, and the entire profile medium to strongly acid.

Following is a description of a typical profile of Wolftever (silt loam) soil:

0 to 9 inches, pale-brown (10YR 6/3, dry) or dark grayish-brown (10YR 4/2, moist) friable silt loam; under virgin conditions upper inch notably dark because of content of partially disintegrated organic matter.

9 to 20 inches, very pale-brown to light yellowish-brown (10 YR 7/4, dry) or yellowish-brown (10YR 5/6, moist) firm to very firm silty clay loam that breaks to medium-sized, fairly well developed, nut-structured fragments.

20 to 36 inches, very pale-brown (10YR 7/4 to 7/6, dry) or strong-brown 7.5YR 5/6, moist) firm to very firm silty clay mottled with gray and brown.

Guthrie series

Practically all of the Guthrie soil developed on local alluvium in sinkholes. The alluvium washed chiefly from areas of Fullerton, Colbert, Talbott, and Sequoia soils. The soil is characterized by a compact clayey subsoil and a grayish color throughout the profile. Internal drainage and surface runoff are very slow. During the wetter seasons, the water table is at or above the surface. During the drier seasons it is well below the surface and the soil profile is dry and hard or compact. On the whole, moisture relations are not favorable for good plant growth, and the productivity generally is low. The soil is medium to strongly acid.

Some of the areas classify well as Planosols, as they have a leached friable eluviated layer underlain by a gray compact silty clay or clay subsoil. Other areas have a younger profile—gray surface layers but subsoils not notably compact—and are more properly classified as Alluvial soils with a gley horizon.

Following is a description of a profile that classifies as a Planosol:

0 to 6 inches, light brownish-gray silt loam with some fine, brown mottlings.

6 to 16 inches, light-gray very firm silty clay that may have some fine, brown and yellow mottlings.

16 inches +, light-gray, mottled with gray, yellow, and brown, very firm silty clay or clay that breaks out as large chunks.

Tyler series

The Tyler soil is a poorly drained Planosol occurring in gentle depressions. In some places the parent material is mixed general alluvium, and in others it is local alluvium derived mainly from soils developed from shales. Like the Guthrie soil, it is predominantly gray and has a compact or tight subsoil. Internal drainage and surface runoff are very slow. The natural fertility is low, and the reaction is medium to strongly acid.

Following is a description of a profile of Tyler silt loam:

0 to 6 inches, light-gray (10YR 7/2, dry) or grayish-brown (10YR 5/2, moist) friable silt loam; very dark-brown and yellow mottlings common to this layer; virgin areas have a notable amount of partly disintegrated organic matter in the surface inch.

6 to 12 inches, very pale-brown (10YR 7/3, dry) very firm silty clay loam to clay with gray and yellow mottlings.

12 to 36 inches, mottled gray and yellow very firm clay.

ALLUVIAL SOILS

The Alluvial great soil group (*16*) consists of 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. In this county these soils (see table 7 p. 221) are on first bottom lands along streams, in depressions, and along drainageways that extend into the upland areas that have nearly level, gently sloping, and depressional relief and good to very slow internal drainage. They have the common properties of soils that lack a soil profile with genetically related horizons. The properties of these soils are closely related to the alluvial deposits. Alluvial soils derived from similar parent material but differing in drainage have been divided according to properties associated with good, imperfect, or poor drainage.

Huntington-Lindside-Roane-Melvin series

The Huntington, Lindside, and Melvin series constitute a cantena of soils derived from mixed general alluvium that apparently has been strongly influenced or dominated by limestone material. Much of their acreage is only slightly acid, and parts may be neutral. Huntington soils are well drained, Lindside imperfectly drained, and Melvin poorly drained. The profiles are not well defined and are considered young to very young. In some places very recent deposits of alluvium are on the surface, and exposure of the profile shows a somewhat older darker surface layer at depths ranging from 6 to 24 inches.

Following is a profile description of Huntington silt loam:

0 to 12 inches, brown (10YR 5/3, dry) or very dark grayish-brown (10YR 3/2, moist) silt loam.

12 to 30 inches, grayish-brown to brown (10YR 5/2 to 5/3, dry) or very dark grayish-brown (10YR 3/2, moist) heavy silt loam that breaks rather easily to irregular moderate-sized fragments.

30 to 50 inches +, pale-brown (10YR 6/3, dry) or brown (10YR 4/3, moist) silt loam to silty clay loam.

The upper 14 to 16 inches of the Lindside soil is quite similar to that of the Huntington. The Lindside profile differs chiefly in being mottled yellow, gray, and brown below this depth. In many places

the Lindside texture is finer and the consistence a little heavier than for the Huntington soils, but these differences are not consistent.

The Melvin soil is classed as an Alluvial soil with a gley horizon. Under average conditions the entire profile is relatively gray as compared to that of the Huntington or Lindside soils, and the subsoil is decidedly gray. In some places there is a layer of very recent alluvium, 6 to 14 inches thick and lighter colored than the somewhat older former surface layer directly below. Some areas of Melvin soil have taken on some characteristics of a Planosol—the subsoil is more compact and clayey than the surface layer.

Following is a description of a Melvin profile:

0 to 6 inches, brownish-gray or very pale-brown (10YR 7/3, dry) silt loam; brown mottlings or specks common; in virgin areas surface three-fourths inch or inch contains a notable amount of partly disintegrated organic matter.

6 to 20 inches, mottled gray, yellow, and strong-brown moderately plastic silty clay loam; in a few places may be silty clay; crushed mass very pale brown (10YR 7/4, dry).

20 inches +, light-gray, mottled with yellow and brown, plastic silty clay; crushed mass white to pale yellow (2.5Y 8/2 to 8/4, dry).

The Roane soil differs from the Huntington soils chiefly in its lighter color, notable amount of chert, lower fertility, and medium acid reaction. In places the cherty matrix at a depth of 24 to 30 inches may be partly cemented, forming a compact mass that is penetrated with difficulty. The Huntington, Lindside, and Melvin soils are on the bottom lands of the large streams such as the Holston and French Broad Rivers as well as the creeks. The Roane soil is confined to smaller stream bottoms where most of the alluvium originated from Clarksville and Fullerton soils.

Following is a description of Roane silt loam:

0 to 14 inches, brown friable silt loam (10YR 5/3, dry) or brown to dark-brown (10 YR 4/3 to 4/2, moist) silt loam to loam with some chert.

14 inches +, white to light-gray (10YR 8/2 to 7/2, dry) very cherty silty matrix; in some places browner, but on the whole light colored; in places mottled.

Staser-Hamblen-Prader series

The Staser, Hamblen, and Prader soils consist of young mixed general alluvium that originated mostly from soils developed over shales. In other words, the parent material for these soils is less influenced by limestone than that of the Huntington group.

This catena includes (1) the fine sandy loams of the bottom lands, which are associated with Huntington, Lindside, and Melvin soils; (2) the soils on the creek bottoms, which have been less influenced by limestone; and (3) the soils on the bottom lands, which consist of materials originating from Tellico soils. In general the soils of this catena are a little lower in fertility and more acid than those of the Huntington, Lindside, and Melvin catena. Nevertheless, they are not strongly acid. The profiles of the Staser and Hamblen soils are less brown than those of the Huntington and Lindside respectively.

Following is a description of the Staser silt loam profile:

0 to 12 inches, grayish-brown or light yellowish-brown (10YR 6/4, dry) silt loam.

12 to 24 inches, light grayish-brown (10YR 6/3, dry) heavy silt loam.

24 to 40 inches +, approximately the same color as layer above with some yellowish and gray mottles below 28 inches and increasing mottling with depth; the reaction according to a field test was pH 6.5 to 7.0.

The Hamblen profile is quite similar to that of the Staser except that the mottles are strong at a depth of about 15 inches. The Hamblen soil areas consisting of alluvium from Tellico soils, however, are notably redder. Their reaction is moderate to slightly acid, and their fertility approximates that of the typical Hamblen.

Following is a profile of the Hamblen variation common to the Tellico association:

0 to 8 inches, reddish-brown (5YR 5/4, dry) or dark reddish-brown (5YR 3/3, moist) loam.
8 to 16 inches, light reddish-brown (5YR 6/4, dry) or reddish-brown (5YR 4/3, moist) friable loam.
16 to 30 inches, pink (7.5YR 7/4, dry) or reddish-brown (5YR 4/3, moist) loam with some brown, yellow, and gray mottles; in places quite mottled.

The texture of this soil varies from fine sandy loam to silt loam; the small parts on the natural levees are loamy fine sand.

The Prader profile resembles that of the Melvin. The areas are consistently heavy in the subsoil, and some have silty clay loam surface layers.

Congaree-Chewacla series

The Congaree and Chewacla soils consist of general alluvium that contains a considerable amount of material derived from soils developed from micaceous rocks, mixed with alluvium originating from limestone, shale, and sandy rock. They are characterized by a notable content of mica, and on the whole are more loamy and friable than the Huntington and Lindside soils. Though somewhat more acid, their color profile and natural fertility approximate those of the soils of the Huntington catena.

Emory and Greendale series

The Emory soils have been developed on local alluvium washed chiefly from Decatur, Dewey, and Farragut soils; whereas the Greendale soils have developed on alluvium washed predominantly from Fullerton and Clarksville soils. These series, as mapped, include both young and moderately old profiles. The young profiles are on the younger deposits, mostly along the drains; and the moderately old are on the older deposits on the sloping parts generally somewhat removed from the drainage channels. The Emory soils are brown or reddish-brown and relatively fertile, whereas the Greendale soils are more yellowish and less fertile. Both are well drained.

The following is a description of a moderately developed profile of Emory silt loam:

0 to 12 inches, brown (10YR 5/3 to 4/3, dry) silt loam.
12 to 24 inches, strong-brown to yellowish-red (7.5YR 5/8 to 5YR 5/6, dry) friable silty clay loam.
24 to 40 inches +, red (2.5YR 4/8, dry) firm silty clay with a medium, moderately developed, blocky structure.

In the younger profiles, the subsoil is less red and there is little evidence of a nut structure.

Following is a description of a profile of Greendale silt loam:

0 to 4 inches, pale-brown (10YR 6/3, dry) loam.
4 to 10 inches, light yellowish-brown (10YR 6/4, dry) silt loam that breaks from place into medium, weakly to moderately developed, nut-structured fragments.
10 to 30 inches, yellow (2.5Y 8/6, dry) silty clay loam that breaks from place into medium, moderately developed, nut-structured fragments.
30 inches +, pale-yellow (2.5Y 8/6, dry) silty clay loam; some mottling is common but not striking.

This description is of an older profile within the range of Greendale soils as mapped in this county. Those parts of the areas along the drains have a less well-developed profile, as evidenced by a less yellowish subsoil and a less well-defined nut structure.

Camp series

The Camp soil consists of local alluvium washed from Bland soils. Most of the acreage has an Alluvial soil profile, but some parts have been in place long enough to have acquired a weak Red-Yellow Podzolic profile. The texture of this soil is finer than that of most Alluvial soils, and the consistence is moderately heavy. The surface 10 inches is weak-red silt loam or silty clay loam, and the subsoil is dusky-red firm silty clay. The reaction ranges from neutral to moderately acid.

Abernathy and Ooltewah series

The Abernathy and Ooltewah are Alluvial soils consisting of local alluvium derived from soils over limestone. A large part, including all of the Abernathy, consists of alluvium from the red soils—Decatur, Dewey, and Farragut. All of the areas are in depressions where runoff is very slow or all drainage is through subterranean channels. Both the Abernathy and Ooltewah are fertile, and their soil material is friable. The Abernathy is well drained and reddish brown to a depth of 30 inches or more in most places. The Ooltewah is imperfectly drained and more nearly yellowish brown than reddish. Neither soil is very strongly acid. The poorly drained soil of this catena is included in the Guthrie series; it represents the Alluvial soil variation noted in the description of the Guthrie series (see Planosols, p. 232).

Following is a description of a profile of Abernathy silt loam:

0 to 18 inches, reddish-brown (5YR 4/3, dry) or dusky-red (2.5YR 3/2, moist) silt loam.
18 to 30 inches, reddish-brown (5YR 4/4, dry) or dark reddish-brown (2.5YR 3/4, moist) silt loam that comes from place in somewhat finer pieces than the material of the surface layer.
30 to 60 inches, yellowish-red (5YR 5/8, dry) or red (2.5Y 4/8, moist) firm silty clay loam; in many places more nearly yellowish brown and may have gray mottlings.

Some areas consist of relatively light colored very recent alluvium 6 to 18 inches thick over a grayish-brown (10YR 5/2, dry) silt loam or a silty clay loam layer that represents the surface layer of a buried Alluvial soil.

Following is a description of a profile of Ooltewah silt loam:

0 to 12 inches, light yellowish-brown (10YR 6/4, dry) or yellowish-brown (10YR 5/6, moist) silt loam.

12 to 24 inches, grayish-brown (10YR 5/2, dry) or dark grayish-brown or dark-brown (10YR 3/2, moist) silty clay loam that comes from place in moderately firm pieces.

24 inches +, mottled yellow and gray silty clay loam; in most areas mottling is at a shallower depth, and the dark layer at 12 to 24 inches, representing a buried surface layer, is not always present.

Whitesburg, Cotaco, and Neubert series

Soils of the Whitesburg, Cotaco, and Neubert series consist of young local alluvium. The Whitesburg is composed principally of material from soils over calcareous shale, chiefly Dandridge and Litz soils; the Cotaco, of material derived from sandstone or sandy shale, chiefly Muskingum, Lehew, and Jefferson soils; and the Neubert, of material chiefly from Tellico soils. All are along drainageways that rise in areas of the upland soils listed. Internal drainage of much of the acreage of Whitesburg and Cotaco soils is moderately poor, whereas the Neubert soils are moderately well drained. All of these soils have weakly or very weakly developed profiles and commonly consist of an Alluvial soil profile buried by a very recent deposit of lighter colored alluvium.

The Whitesburg profile consists predominantly of 10 inches or more of brownish-gray silt loam over light-yellow silt loam that extends to a depth of 18 inches. Below this is mottled yellow and gray friable silty clay loam. Most of this soil is weakly acid to neutral.

The Cotaco soil consists of 8 or 10 inches of yellowish-gray fine sandy loam, below which is yellow friable fine sandy clay loam. Below a depth of about 20 inches is mottled yellow, gray, and brown friable very fine sandy clay loam or silty clay loam. This soil is medium to strongly acid.

The Neubert soils consist of about 12 inches of reddish-brown (5YR 5/3, dry) loam underlain by reddish-brown or brownish-red friable clay loam. These soils are noticeably permeable in most places and medium acid.

LITHOSOLS

The Lithosol great soil group (*16*) is an azonal group of soils having no clearly expressed soil morphology and consisting of a freshly and imperfectly weathered mass of rock fragments, largely confined to steeply sloping land. The positions these soils occupy (see table 7) are conducive to relatively rapid geologic erosion. The soils generally consist of materials that are easily eroded. As a result, material is removed from the surface or so mixed that soil-forming processes have not acted on it long enough to produce well-defined genetic soil properties. As mapped these soils may include small areas of zonal soils.

Armuchee series

Well defined A, B, and C horizons have not developed in the Armuchee soils; cultivation and accelerated erosion have tended to obliterate the incipient horizon differentiation found in virgin areas. These soils have developed on hilly to steep relief from weathered products of interbedded limestone and shale similar to those underlying the Sequoia soils. Normal erosion in the Armuchee soils, however, has kept pace with weathering processes, and the well-defined A, B, and C profile of the Sequoia soil has not developed. The difference between the Armuchee and the Litz soil apparently results

from the higher percentage of limestone in the parent rock of the Armuchee series.

A representative Armuchee profile is as follows:

0 to 1 inch, dark-gray, very friable silt loam, high in organic matter.
1 to 6 inches, brownish-gray friable silt loam with a weak, medium crumb structure.
6 to 20 inches, reddish-yellow to yellowish-red plastic silty clay splotched with red, yellow, gray, and brown; numerous shale fragments.
20 inches +, interbedded shale and limestone; the lime is leached out of the upper 1 to 2 feet in most places.

In some places slight illuviation is recognizable in a layer lying between depths of 6 and 12 inches. In this layer the material is a uniform reddish-yellow silty clay with medium, weakly developed, blocky structure.

Dandridge series

The soils of the Dandridge series have formed from the residuum of calcareous shale. They are predominantly hilly to very steep. On such areas 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. These soils are neutral to slightly acid.

Representative profile:

0 to 1 inch, brownish-gray very friable silt loam stained dark with organic matter.
1 to 6 inches, yellowish-gray friable shaly silt loam.
6 to 24 inches, brownish-yellow to reddish-yellow moderately plastic shaly silty clay loam; contains large amount of soft partially disintegrated shale fragments; layer lighter in the lower part and mottled with yellow and gray.
24 inches +, calcareous shale bedrock.

Litz series

The Litz soils have developed chiefly from soft acid shale interbedded with widely spaced layers of limestone or calcareous shale that is leached to a depth of several feet. In some of the parent material the layers of limestone have disappeared through weathering, and only shale remains at the surface. The parent rocks differ from those of the Armuchee in containing much less limestone.

The Litz soils are prevailingly very shallow—shallower and lighter colored than the Armuchee soils. They typically range from about 4 to 14 inches in depth to shale. The soil material is predominantly grayish-yellow friable silt loam to silty clay loam. Shale fragments are generally numerous throughout the soil mass. In woods and old pastures the topmost 1 or 2 inches of soil is stained dark with organic matter. The soil is prevailingly moderately to strongly acid. In a few places there is a weakly developed profile somewhat similar to that of the Sequoia soils.

Following is a typical profile:

0 to 4 inches, yellowish-gray silt loam; under virgin conditions the upper part of the layer contained a notable amount of partly disintegrated organic matter.
4 to 12 inches, brownish-yellow or reddish-yellow firm but friable silty clay loam that may contain some shale fragments; variegated brown, yellow, and red soft shale below this; dark-gray calcareous shale may be at a depth of about 5 feet.

Montevallo series

The Montevallo soils consist of weathered materials from acid shales. They are very shallow to the shale beds. On some of the smoother parts, there is an incipient illuviated layer. A few shale fragments are in the surface layer in most places. The soils are low in fertility and medium to strongly acid.

Profile description of a Montevallo soil:

0 to 5 inches, grayish-yellow silt loam that may contain shale fragments.
5 to 14 inches, brownish-yellow shaly silt loam or shaly silty clay loam, underlain by gray fissile shale.

Muskingum series

The Muskingum soils consist of weathered materials from acid light-colored sandstone or sandy shale. They are shallow. The depth to bedrock averages about 20 inches but varies from about 10 inches to 3 feet. The Muskingum soils from sandy shale are intricately associated with the Lehew soils and are not very stony; the Muskingum soils from sandstone consist mostly of sand containing many sandstone fragments.

A representative profile of Muskingum stony fine sandy loam is as follows:

0 to 1 inch, medium-gray loose very friable fine sandy loam, moderately high in organic matter; many stone fragments on the surface.
1 to 10 inches, yellowish-gray very friable stony fine sandy loam; in places grades at 10 or 12 inches to brownish-yellow friable sandy clay loam, with bedrock at depths of 18 to 24 inches.

Lehew series

The Lehew soils consist of materials weathered from interbedded sandstone and shale. They are conspicuous because the parent rocks, as well as the soil parent materials, are dusky red. The soil material ranges from about 10 to 20 inches deep over bedrock. The reaction is generally strongly to very strongly acid.

Representative profile:

0 to 1 inch, medium to dark-gray loose very friable loam.
1 to 8 inches, grayish-brown to weak-red very friable loam or fine sandy loam.
8 to 20 inches, light-brown to weak-red friable loam or light clay loam mixed with partially weathered red, dusky-red, and olive sandstone and shale fragments.

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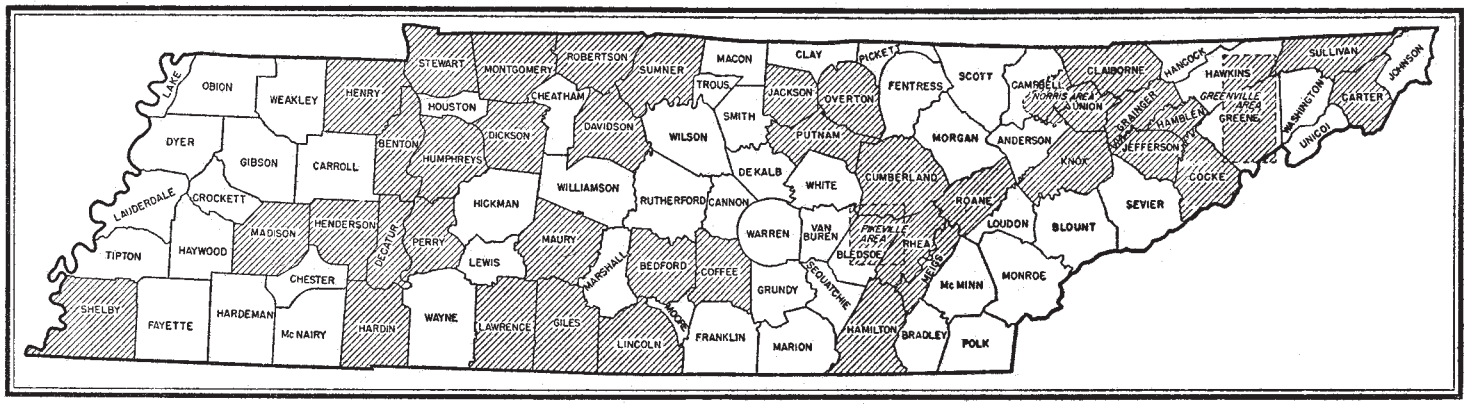

Areas surveyed in Tennessee shown by shading.

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