Series 1938, No. 25 Issued April 1950

Soil Survey

Cumberland County Tennessee

By
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United States Department of Agriculture

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and Agricultural Engineering
In cooperation with the
TENNESSEE AGRICULTURAL EXPERIMENT STATION
and the
TENNESSEE VALLEY AUTHORITY

HOW TO USE THE SOIL SURVEY REPORT

SOIL SURVEYS provide a foundation for all land use programs. The report on each survey and the map that accompanies the report present information both general and specific about the soils, the crops, and the agriculture of the area surveyed. The individual reader may be interested in the whole report or only in some particular part. Ordinarily he will be able to obtain the information he needs without reading the whole. Prepared for both general and detailed use, the report is designed to meet the needs of a wide variety of readers of three general groups: (1) Farmers and others interested in specific parts of the area; (2) those interested in the area as a whole; and (3) students and teachers of soil science and related agricultural subjects. Attempt has been made to meet the needs of all three groups by making the report comprehensive for purposes of reference.

Readers interested chiefly in specific areas—such as some particular locality, farm, or field—include farmers, agricultural technicians interested in planning operations in communities or on individual farms, and real estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. These readers should (1) locate on the map the tract with which concerned; (2) identify the soils on the tract by locating in the legend on the margin of the map the symbols and colors that represent them; and (3) locate in the table of contents in the section on Soils the page where each type is described in detail and information given as to its suitability for use and its relations to crops and agriculture. They will also find useful specific information in the sections on Physical Land Classification and Soil Management, and Estimated Yields and Productivity Ratings.

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, docks, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and for recreation. The following sections are intended for such users: (1) General Nature of the County, in which physiography, relief, drainage, climate, water supply, vegetation, organization, population, industries, transportation, markets, cultural development, improvement are discussed; (2) Agriculture, in which a brief history and the present status of the agriculture are described; (3) Physical Land Classification and Soil Management, and Estimated Yields and Productivity Ratings, in which the soils are grouped according to their relative physical suitability for agricultural use and their present management requirements are discussed, the present use and productivity of the soils described and suggestions made for improvement.

Students and teachers of soil science and allied subjects—including crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology—will find their special interest in the section on Morphology and Genesis of Soils. They will also find useful information in the section on Soils, in which are presented the general scheme of classification of the soils of the area and a detailed discussion of each type. For those not already familiar with the classification and mapping of soils, these subjects are discussed under Soil Survey Method and Definitions. Teachers of other subjects will find the sections on General Nature of the County, Agriculture, Physical Land Classification and Soil Management, and Estimated Yields and Productivity Ratings, and the first part of the section on Soils of particular value in determining the relations between their special subjects and the soils of the area.

This publication on the soil survey of Bedford County, Tenn., is a cooperative contribution from the—

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SOIL SURVEY OF CUMBERLAND COUNTY, TENNESSEE

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

CONTENTS

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

CUMBERLAND COUNTY, lying almost wholly on the Cumberland Plateau, is primarily agricultural, although a large part has never been cleared. The people derive most of their cash income from lumbering and mining and most of their food from farming. At present agriculture consists chiefly of the production of crops, although livestock and livestock products are a source of some income. The most fully developed agricultural areas are in Sequatchie Valley and Grassy Cove. Corn, hay, and wheat are the principal subsistence crops, and some potatoes, sweetpotatoes, beans, tomatoes, cabbage, and sweet corn are grown for sale. Most farms have a vegetable garden and an orchard for home supply of fruit. To provide a basis for the best uses of the land, a cooperative soil survey was

begun in 1938 by the United States Department of Agriculture, the Tennessee Agricultural Experiment Station, and the Tennessee Valley Authority. Following is a summary of the essential features of the survey.

SUMMARY OF THE SURVEY

Cumberland County, Tenn., situated almost entirely on the Cumberland Plateau, is characterized by smooth stone-free land on interstream divides and sloping stony land along the drainageways, except the Crab Orchard Mountains, which are prevailingly steep and stony. Elevations range from somewhat less than 1,000 feet to slightly more than 3,000. Practically all the area is well drained.

The soils of the uplands on the Cumberland Plateau cover 388,219 acres; colluvial lands, 865 acres; stream terraces, 898 acres; and bottom lands, 8,802 acres. Miscellaneous land types cover 33,536 acres.

About 42 percent of the county is relatively stone-free, and 50 percent is stony enough to interfere materially with cultivation. In the remainder, outcroppings of bedrock make cultivation infeasible, and in some parts render the land of little value for crops, pasture, or forest.

The soils differ widely in physical suitability for use and in management requirements. Such differences are caused by a number of soil characteristics, as texture, structure, consistence, quantity and character of organic matter, chemical composition, moisture relations, depth to bedrock, erosion, stoniness, and slope. These soil features and conditions affect the workability, conservability, and productivity of the soil and thereby its use and management. The soils are grouped in five classes, according to their degree of desirability for agriculture.

In about 98 percent of the county the soils are rather uniform in color, texture, structure, and character of parent material. These soils are low in content of organic matter, lime (available calcium), phosphate, and possibly other constituents needed for plant growth.

Expected average yields on each soil for the main crops and for pasture are estimated for different levels of management. Good management is essential in maintaining soil productivity, and most of the soils respond well to it. Management practices for the production of crops include rotations of sod crops, legumes, and grasses; the use of amendments, mainly superphosphate and ground limestone; the use of green manure; and suitable tillage. Poor drainage affects only a relatively small total acreage of the land in the county.

Study of the morphology and genesis of soils reveals the factors of soil formation and provides the basis for classifying, naming, and describing 17 soil series, and learning their differentiating characteristics and the relation of each to agriculture.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Cumberland County occupies 675.5 square miles in the central part of eastern Tennessee (fig. 1). Crossville, the county seat and geographic center of the county, is 65 miles north of Chattanooga, 60 miles west of Knoxville, and 100 miles east of Nashville.

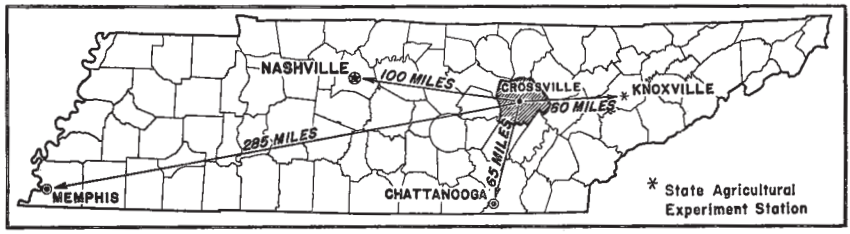


FIGURE 1.—Location of Cumberland County in Tennessee.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

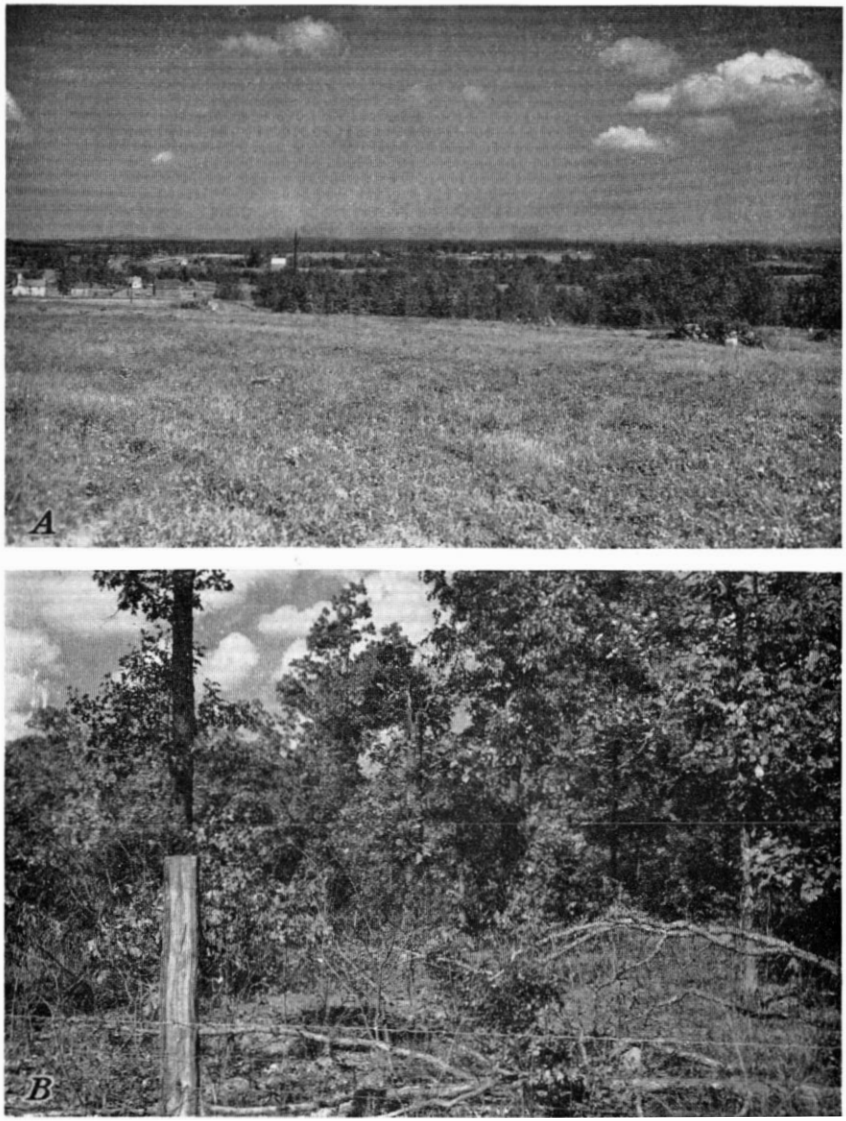
Physiographically, the county is situated almost wholly on the Cumberland Plateau, which is a part of the Appalachian Plateaus province (*4*).[2] This plateau is marked by a narrow intermittent valley that includes Crab Orchard Gap and Grassy, Little, and Swagerty Coves and the upper reaches of the Sequatchie Valley. Sandstone and shale are exposed over most of the plateau, and limestone in the various coves and in the Sequatchie Valley. In general, the Cumberland Plateau has a smooth surface, dissected by young valleys whose steepness and depth increase toward the edges (pl.1, *A*).

Including Daddy Creek and thence southeast to the county boundary, the permanent streams and many of the intermittent ones have cut deep V-shaped valleys, the floors of which in many places lie 400 to 600 feet below the surrounding plateau. The area lying southeast of the Crab Orchard Mountains is so thoroughly dissected by drainageways that land level enough for use in crop production is scarce. Northwest of Daddy Creek the elevation is 1,800 to 2,000 feet above sea level [3] and the land is gently undulating to gently rolling except where dissected by the permanent streams and main intermittent drains. Here many of the streams have cut valleys 100 to 400 feet deep. The stony slopes are of 15 to 30 percent gradient, though sheer drops of 20 to 150 feet occur in places. Comparatively smooth land occupies about half the area. In the southwestern part, stream dissection has been thorough and not much level land exists.

The Sequatchie Valley, in the southern part, extends in the same direction as the Crab Orchard Mountains and has resulted from the erosion of the Sequatchie anticline. Folding exposed softer rock than that capping the Cumberland Plateau and made possible the more rapid weathering that brought about the formation of the valley.

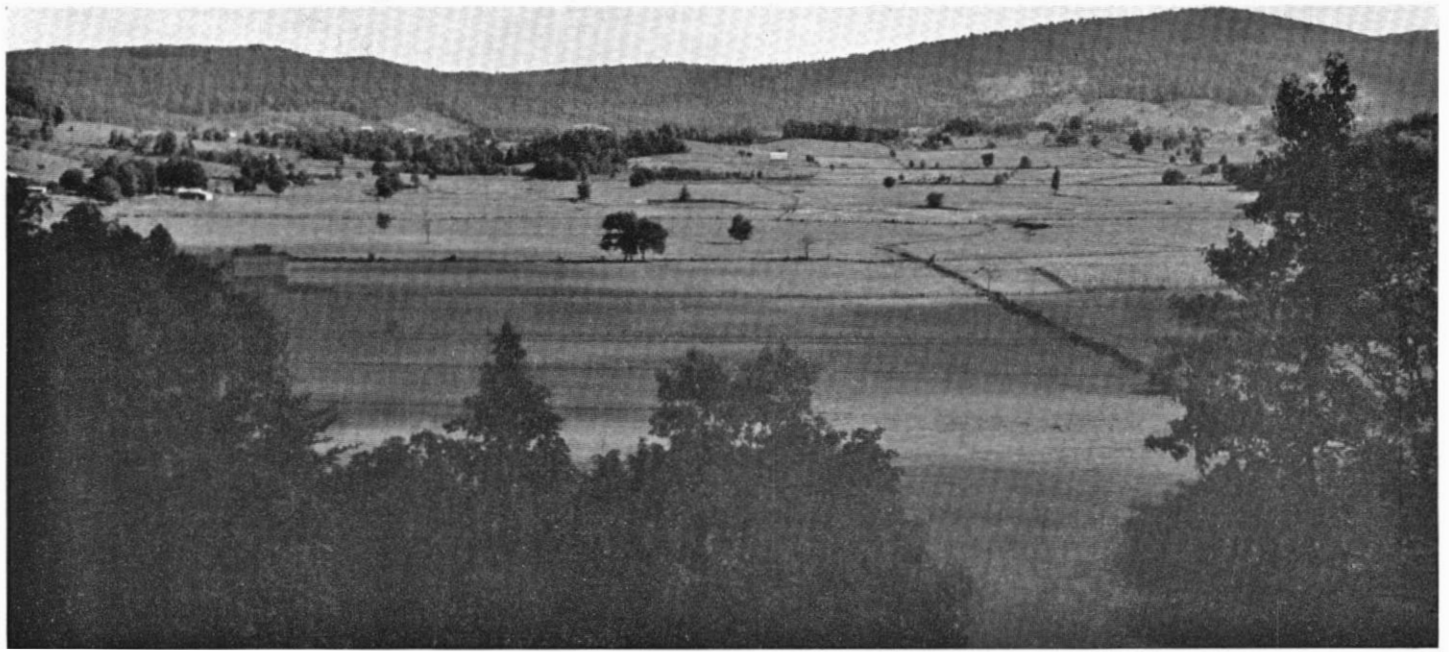
The intermittent valley, consisting of a series of coves, extends from near Crab Orchard southwestward to the Sequatchie Valley. It includes 6 coves ranging in size from about 40 to 3,000 acres. The floors of the coves are 200 to 400 feet lower than the general elevation of the Cumberland Plateau and 800 to 1,500 feet lower than the surrounding mountains. In most places these differences in elevation occur within a space of a half to three-quarters of a mile, causing rugged relief around the coves. Drainage of all but one of the coves collects in sinkholes or caves; that of the one located about

[2] Italic numbers in parentheses refer to Literature Cited, p. 107.
[3] Elevation data from U. S. Geological Survey topographic maps.



A, An area of a fairly high plateau dissected by a dendritic system of drainage, typical of the surface of Cumberland County. The ridge tops are undulating and rolling, and the slopes leading to drainageways are in most places steep. Much of the broader parts of the smooth ridge land has been cleared for cultivation, whereas most of the land on the steep slopes has been left in forest.

B, Cut-over forest of second-growth hardwoods, mostly blackjack oak, on Hartsells fine sandy loam.



Grassy Cove, a large limestone sink in the southeastern part of the county. The crests of the highest ridges in the background are nearly 1,000 feet above the sink floor. Muskingum soils and Rough stony land (Muskingum soil material) are on the wooded mountain slopes. Talbott soils and Stony land (Talbott soil material) are on the lower cleared slopes and the low rolling hills in the middle distance. The level area in the middle foreground is an alluvial plain. Atkins, Philo, Dunning, and Huntington soils are on the bottom lands; Wolftever and Holston soils on the low terrace lands; and Jefferson soils on the colluvial fans and benches. Trees in the immediate foreground are on Rough stony land (Muskingum soil material).

a mile southwest of Crab Orchard finds an outlet in Meadow Branch, which empties into Daddy Creek.

Grassy Cove, embracing approximately 3,000 acres (pl. 2), is the largest and most important of these coves. This cove empties into a cave or opening on its west side and, according to local information and other sources, the water flows under a mountain and comes out as a large spring that forms the source of the Sequatchie River. The distance from the cave to the spring is about 5 miles, and the elevation drops about 500 feet between these points. The mouth of the cave into which the drainage of the Grassy Cove flows is approximately 8 by 10 feet, but the underground channel is not large enough to carry off the water from heavy rains, and a temporary lake forms, its size depending on the duration and intensity of the rains. Sometimes the lake almost covers the cove.

The elevation of the county ranges from somewhat less than 1,000 feet to slightly more than 3,000. The lowest point is in the Sequatchie Valley; the highest, on Hinch Mountain, is about a mile distant. Elevations of several places are as follows: Pleasant Hill, about 1,950 feet; Mayland, 1,950; Pomona, 1,920; Crossville, 1,881; Newton, 1,702; Crab Orchard, 1,690; Genesis, 1,644; and Grassy Cove, 1,534.

Drainage is dendritic and in general well established (fig. 2).

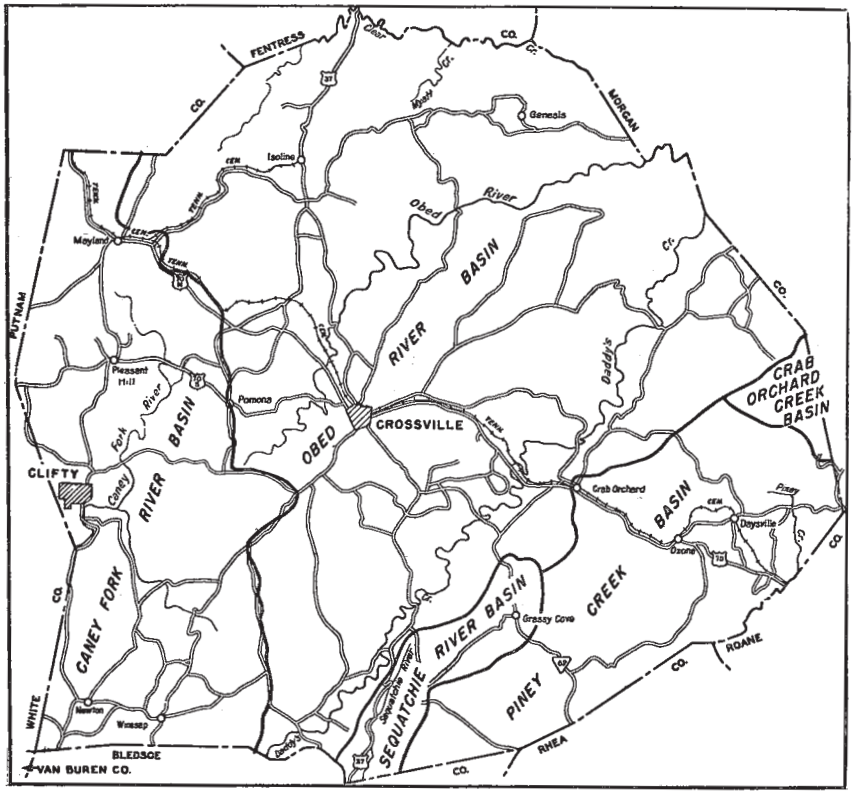


FIGURE 2.—The main drainage basins in Cumberland County, Tenn. (Small diagonally hatched area on western boundary a part of White County: see map, cover page 3, for detail.)

About three-fourths of the county drains into the Tennessee River, and the other part into the Cumberland River. Here and there on the uplands of the Cumberland Plateau are small poorly drained areas, and in many places small seepy spots are present on slopes. Some soils of the bottom lands have both slow external and internal drainage.

CLIMATE

The climate of Cumberland County is temperate and continental—the winters are moderate, with short cold periods, and the summers are mild, with cool pleasant evenings. Summer temperatures higher than 90° F. are rare. The difference between the mean summer and winter temperatures is about 33°. The climate is somewhat cooler, particularly in summer, than that of the Great Valley of east Tennessee to the east and that of the Central Basin to the west. The mean seasonal temperatures on the Cumberland Plateau in winter are 38.7°; in spring, 54.7°; in summer, 72.1°; in fall, 57.0°; and the mean annual temperature is 55.6°.

An average frost-free period of 179 days, extending from April 18 to October 14, provides ample time for the maturing of all crops generally grown on the Cumberland Plateau. Killing frost, however, has occurred as late as May 24 and as early as September 22. The grazing period usually extends from the middle of April to the middle of November.

Mild and open winters permit outdoor farm work to be performed on most days. Wheat, rye, and oats are planted in fall and survive most winters without appreciable damage from freezing, especially on well-drained soils. The winters are mild enough for growing certain vegetables.

The average annual precipitation of 54.19 inches is well distributed and generally ample even for the most exacting crops. About 82 percent of it comes during winter, spring, and summer, and is about the same for each of these seasons. The lightest rainfall is in fall, coinciding with the ripening and harvesting of many crops. Sometimes crops are damaged because of too little rain, especially on soils of low moisture-holding capacity; and sometimes they are damaged by too much rain, especially on soils in poorly drained bottom lands.

Fairly uniform climatic conditions prevail, except on the Crab Orchard Mountains, in Grassy Cove, and in the Sequatchie Valley. Owing to the lower position of the last two features, the average temperature is higher, and the frost-free period is longer than on the Cumberland Plateau, especially in the Sequatchie Valley, which has a climate comparable with that of the Great Valley of east Tennessee. In the Sequatchie Valley where the elevation is about 950 feet above sea level (*17*), or slightly more than 900 feet lower than the elevation of the Weather Bureau station at Crossville, the frost-free season is about 3 weeks longer than that of the Cumberland Plateau, or about 189 days (*10*). On the Crab Orchard Mountains, where the elevation is about 1,000 feet higher than at Crossville, the frost-free period would be expected to be somewhat shorter.

Although local variations in temperature and precipitation are difficult to substantiate, it is apparent that such variations exist. They may be caused by lay of the land, including direction of slope;

the effect of relief on air drainage; variations in elevation; and proximity and relation to mountains. At times frost kills vegetation in valleys and depressions but does not damage vegetation on ridges.

Local variations in rainfall may be due partly to the fact that much of the rain late in spring, in summer, and early in fall comes in the form of thundershowers that often cover strips only 3 or 4 miles wide, resulting in uneven local distribution. Some areas may have ample rain, while nearby areas may have drought, but nevertheless, rainfall is usually adequate for the production of all crops grown in the county. Destructive hailstorms and tornadoes are not common. The prevailing winds blow from the south and southwest.

Climatic data for the United States Weather Bureau station near Crossville, as given in table 1, may be considered fairly representative of weather conditions in this county.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation near Crossville, Cumberland County, Tenn.*[1]

[Elevation, 1,810 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snowfall
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	38.9	71	−13	5.24	2.04	7.84	2.7
January	37.7	70	−14	4.99	2.50	5.32	3.0
February	39.5	76	−8	4.65	4.17	4.10	3.2
Winter	38.7	76	−14	14.88	8.71	17.26	8.9
March	45.6	81	1	5.92	5.53	9.69	1.8
April	55.3	91	14	4.79	6.48	8.16	.1
May	63.3	93	32	4.10	3.28	5.51	0
Spring	54.7	93	1	14.81	15.29	23.36	1.9
June	70.5	100	38	4.52	2.45	7.06	0
July	73.6	102	40	5.62	2.39	7.10	0
August	72.1	102	41	4.55	2.50	9.28	0
Summer	72.1	102	38	14.69	7.34	23.44	0
September	68.2	103	27	3.30	5.31	1.72	0
October	56.9	90	18	3.17	2.28	2.85	.1
November	45.9	78	0	3.34	1.57	1.42	1.2
Fall	57.0	103	0	9.81	9.16	5.99	1.3
Year	55.6	[2] 103	[3] −14	54.19	[4] 40.50	[5] 70.05	12.1

[1] From U. S. Weather Bureau records.
[2] September 1925.
[3] January 1918.
[4] In 1943.
[5] In 1922.

WATER SUPPLY

The streams furnish ample water for the range livestock and for livestock on nearly all farms. Water for domestic use on most farms comes from wells 30 to 50 feet deep, many of which will not yield more than 50 gallons at one pumping. Where large quantities are needed, as for spraying, small dams are made across short intermittent drains. Most of the year the permanent streams carry clear water of bluish-green tinge. In fall they appear to be dark, owing to the decomposition of leaves that drop into them, especially in places where the water flows slowly.

The county has no natural lakes, but a few small artificial ones have been made by damming small creeks. A lake covering about 500 acres constructed by the town of Crossville affords recreational facilities and a water supply for municipal requirements.

ORGANIZATION AND POPULATION

Cumberland County, one of the more recent counties to be organized in the State, was formed in 1856 from parts of Fentress, Putnam, Roane, Bledsoe, Morgan, and White Counties. A white settlement was made in the territory now occupied by this county as early as 1799. According to the older residents a stage road was laid out about that time between Nashville and Washington, passing through Knoxville. Another road laid out at an early date between Kentucky and Alabama was called the Old Stock Road, and its intersection with the stage road was known as the Crossroads, later named Crossville.

The first settlements in the county were at Johnsons Stand, now called Mayland, and Crab Orchard, which were stagecoach stations. Many of the early settlers, chiefly of English and German descent, came from the adjoining counties, from North Carolina, Georgia, and Pennsylvania, and a few from other States and Canada. Some were veterans of the Revolutionary War, who had been given grants of land.

According to the Federal census the population, all classed as rural, increased from 4,538 in 1880 to 15,592 in 1940, of which 15,577 were native white, 14 foreign-born white, and 1 Negro. The average density in 1940 was 23 persons a square mile. The population is sparse in the Crab Orchard Mountains but is more or less evenly distributed in other parts except along paved highways, where it is most numerous.

Crossville, with a population of 1,511 in 1940, is the largest town and marketing place and shipping point for the central part. Crab Orchard serves as a trading center and shipping point for the eastern part; other shipping points are Mayland and Daysville. Pleasant Hill, Isoline, Grassy Cove, and Pomona are other small towns.

INDUSTRIES

Cumberland County is primarily agricultural although a large part has never been cleared for agricultural use and comprises mainly cut-over land. Cropland may be increased by clearing that part suitable for cultivation. Mining and lumbering also are important and have influenced the agriculture considerably. These industries have tended to bring about a subsistence, or self-sustaining, type of farming—the people on the land derive most of their cash income from lumbering and mining and most of their food from farming.

The chief products of the mines are Crab Orchard sandstone for flagstone and rubble, limestone for agricultural uses and road metal, and coal for domestic and commercial uses.[4] Crab Orchard sandstone has a national market because of its unusual and attractive coloring. Except for the Sequatchie Valley and the intermittent valley consisting of a row of coves, this county is underlain by coal-bearing or carbonaceous rocks of the Pennsylvanian series. There are many

[4] Data supplied by the Commerce Department, Tennessee Valley Authority.

coal mines, but most of them are small and are operated by a few men. Most of the coal is transported by motortruck to neighboring towns. The largest mine is at Isoline, a station on a branch of the Tennessee Central Railway.

Lumbering, though not so important as formerly, still brings into the county considerable revenue. It should continue to be a source of cash income, provided the forests are properly managed. Small wood-working industries have operated at or near Crossville for many years. One of them, a small concern with national markets, manufactures handles. There is also a lumber mill and several sawmills.

In 1939 pottery clay was prospected and when tested was found suitable for lower grade dinner ware. A plant for the manufacture of hosiery is at Cumberland Homesteads, and markets for the product are widespread. In 1940 the census reported 183 persons employed in manufacturing industries. According to the same census a total of 115 farms reported business with or through cooperatives.

TRANSPORTATION AND MARKETS

One railroad—the Tennessee Central Railway Company, two Federal highways, and two State highways serve the county, making possible the transportation of products directly to any of the surrounding markets. The railroad bisects the county in a northwest-southeast direction, passing through Crossville.

The county roads are fair in some places, but many need improvement to enable the farmers to market their products economically and to transport lime and fertilizer. Most of the county and private roads are passable in dry weather, but in winter many are passable only with difficulty. In 1940, according to farms reporting, 343 were on hard-surfaced roads; 807 on gravel, shale, or shell roads; 220 on improved dirt roads; and 642 on unimproved dirt roads. These farms are classified according to the highest type of road serving them.

Knoxville, Nashville, Chattanooga, and Cookeville are principal markets within the State. At the present time, however, most of the potatoes, the principal cash crop of the county, are sold in Alabama, Florida, and Georgia, one of the chief markets being Birmingham, Ala. Livestock and livestock products are marketed mostly in Knoxville, Nashville, Chattanooga, and Cookeville.

CULTURAL DEVELOPMENT AND IMPROVEMENT

The general farm improvements, prevailing condition of buildings, and the extent of modern conveniences in the homes are not so closely related with soil conditions as in many other counties of the State. Better living conditions prevail along the paved and main gravel highways. In Grassy Cove and Sequatchie Valley, however, where the most fertile soils are found, the farm homes, conveniences, and improvements are in general much better than on the Cumberland Plateau. These observations exclude the subsistence homestead houses erected by the Government in the Cumberland Homesteads project near Crossville, which are well built and equipped with a number of modern conveniences.

The farmers of the county have fewer conveniences and improvements than in the more productive agricultural districts of the State. Except those along Federal and State highways, few have telephone facilities. The 1940 census reported telephones on 96 farms. Most of the towns are supplied with electricity, but except those in the Cumberland Homesteads and on Federal and State highways, only a few have electricity. In 1940, 725 farms reported electric distribution lines within one-fourth mile of the farm dwelling. Of this number, 463 had dwellings lighted by electricity, 458 receiving current from the power lines, and 5 from home plants.

Rural mail delivery reaches practically all parts of the county. Schools and churches are situated at convenient places in nearly all parts. A few families living in the Crab Orchard Mountains are 3 or 4 miles from a church or school.

AGRICULTURE

Agriculture in Cumberland County is not so fully developed as in some other parts of the State. As late as 1940 only 11.7 percent of the area was classed as improved land according to the Federal census. The first settlements resulting in any considerable agricultural development were in Grassy Cove and Sequatchie Valley; some land in these places has been cleared and farmed for more than 100 years. Except a few small coves and the area of the Cumberland Homesteads, Grassy Cove and Sequatchie Valley are practically the only parts where all or nearly all the crop-adapted land has been utilized for agriculture.

Although information is meager, the early agriculture no doubt consisted primarily of the production of subsistence crops. Corn, the principal crop, was adapted to the virgin soil and provided a staple food for man and livestock. Important among the factors that have retarded the development of agriculture have been (1) the relatively low soil fertility; (2) availability of more productive soils elsewhere; (3) transportation difficulties; and (4) the reliance for cash income on lumbering and coal mining rather than on agriculture.

As was true of all the Cumberland Plateau in Tennessee, this county was considered unfavorable for settlement by the early pioneers because of the low fertility of the soils. Without the use of lime and phosphate the soils even in their virgin condition were generally low in productivity. The use of these amendments and other fertilizers was practically unknown among the early settlers, and as long as an abundance of fertile land was easy to obtain elsewhere, there was little incentive for the development of agriculture.

As water-transportation facilities were not available, all products bought or sold had to be hauled in wagons and the livestock driven long distances to markets. This was undoubtedly one of the principal causes that retarded the development of agriculture. When the Tennessee Central Railway between Knoxville and Nashville was built through this county in 1899, new markets were opened. Later, the development of autotruck transportation further increased the number of available markets.

Settlement also increased with the building of the railroad, but at that time the people were interested in agriculture primarily as a means of subsistence. Their occupation was chiefly lumbering and later, coal mining. As late as 1910 farmers depended to a large extent on the forests for cash income and used their crops mostly as subsistence for themselves and their livestock.

At the present time agriculture consists chiefly in the production of crops, although livestock and livestock products are a source of cash income. Corn, hay, and wheat are the principal subsistence crops, and some potatoes, sweetpotatoes, beans, tomatoes, cabbage, and sweet corn are grown for the markets. Most farms have a vegetable garden and an orchard for home supply of fruit, mainly apples, and many keep one or more milk cows, a few hogs, and a flock of chickens.

CROPS

The principal field crops are corn, wheat, hay, potatoes, and sweetpotatoes—the latter two grown in lesser quantities as cash crops. The others are largely subsistence crops, although some wheat and corn may be sold locally. The quantity of the principal crops produced is generally not sufficient to supply the county needs. Hay consists mainly of lespedeza, red clover, and timothy; other legumes and tame grasses; and wild grasses. Grains for cutting green occupy a fairly large acreage. Some corn is hogged or grazed off or cut for fodder.

Since the census reports of 1879, the acreage and production of the various crops have fluctuated somewhat. The more significant changes in the relative importance and acreage of the crops in the period 1879 to 1939 are the following: A 41-percent increase in the acreage of corn; practical elimination of oats and rye for grain; a fairly large decrease in the acreage of wheat for grain; and an almost thirtyfold increase in the acreage of hay crops. Since 1889, the acreages of potatoes and sweetpotatoes almost trebled, though the acreage in sorghum for sirup somewhat declined.

Hay, one of the most important crops, occupied 14,907 acres in 1939, exclusive of sorghums. Lespedeza has rapidly gained acreage in the last few years and is now probably the most important hay crop. It is followed in importance by red clover and mixed timothy and clover. The recent increased use of lime and phosphate has encouraged the growing of more legumes for hay, particularly red clover. Most of the hay is fed to livestock on the farms, though some may be sold locally. Crimson clover is becoming popular as a cover and green-manure crop and for pasture, and may be used for hay.

Corn is a very important crop and is second to hay in acreage. The average yields consistently decreased in the first four census years from 15.1 bushels an acre in 1879 to 11.9 in 1909, but in 1919, 1929, and 1939 the greater use of fertilizer increased the yield to about 20 bushels. Most of the corn is consumed on the farm, both as feed for livestock and as home food. That for food is generally ground into meal at local mills and used mainly for corn bread, an important part of the farmer's diet. Corn is grown on practically all the crop-

adapted soils. Federal census reports indicate no marked change in the total corn acreage since 1879, except the comparatively large acreage in 1939. The proportion of corn acreage to the total acreage of cleared land has diminished, while the acreage of cleared land has expanded.

Potatoes, although third in acreage, constitute the most important cash crop. The acreage increased consistently from 469 in 1889 to 1,379 in 1939, with a rather consistent increase in average yields from 55.9 bushels an acre in 1889 to 91.8 bushels in 1939. Most of the potatoes are grown on Hartsells fine sandy loam. A part of the potato crop is consumed on the farms and locally, but the greater part is sold at southern markets, particularly in Alabama and Florida. Some of the potatoes shipped to Florida are used for seed.

The wheat acreage decreased from 517 in 1879 to 59 in 1929 but increased to 326 in 1939. The average acre yields ranged between 5.4 and 9.0 bushels from 1879 to 1929 and dropped to 8.1 in 1939. Wheat is grown on most of the well-drained soils adapted to crops. Much of it is ground into flour at local mills for domestic use, some is fed to poultry, and some is sold at the local markets.

Oats, rye, sweetpotatoes, sorghum for sirup, and tobacco occupy a small total acreage. The acreage in oats decreased from 1,366 in 1879 to 135 in 1939, and in the same period that of rye decreased from 786 to 85. In 1939 the average yield of oats was 20.4 bushels an acre and of rye, 6.4 bushels. The acreage of sweetpotatoes was 134 in 1879 and 277 in 1939, with average yields of 49.7 and 93.4 bushels, respectively. A large part of the sweetpotato crop is used in the farm homes, and some is sold locally.

Tobacco has never been an important crop. The largest total acreage, 36 acres, was reported by the Federal census in 1899. In 1939, 71 farms reported tobacco on a total of 22 acres, and the average acre yield was 548.6 pounds. Sorghum for sirup, produced mainly for home use, was grown on 116 acres in 1939 and yielded an average of 53.3 gallons of sirup an acre. Garden vegetables are grown on most farms, and in 1939 a total of 1,791 farms reported vegetables, excluding potatoes and sweetpotatoes, grown for home use, valued at $130,287. There has been an increased interest in the production of vegetables in recent years. A cannery has been built on the Cumberland Homesteads. In 1939, a total of 40 farms grew vegetables for sale, mainly beans, tomatoes, cabbage, and sweet corn, the acreages in each being 15, 7, 4, and 4, respectively. Less than three farms reported the production of lima beans, beets, carrots, onions (dry), turnips, and watermelons for sale. Three farms produced sweet peppers on a total of less than 1 acre. Three farms reported a total of 7 acres in horticultural specialties, as flower and vegetable seeds, bulbs, and flowers and plants grown in the open, with sales amounting to $6,050.

Fruit growing has never been of great importance. Apples and peaches are the main tree fruits. About three-fourths of the farms

reported apple trees in 1939. The number of bearing apple trees increased from 46,213 in 1889 to 66,253 in 1909 and then decreased to 30,613 in 1939, and in the same years the number of bearing peach trees increased from 4,475 to 10,125 and then decreased to 7,815. Less important tree fruits are cherries, pears, and plums. Grapes, the most important small fruit, are grown on a fairly large number of the farms. Strawberries were harvested from 19 acres, and tame raspberries from 3 acres. A few farms reported a small number of fig, apricot, quince, and pecan trees. Land in bearing and nonbearing fruit orchards, vineyards, and planted nut trees comprised 724 acres on April 1, 1940, on the 617 farms reporting.

The acreages of the principal crops and the number of bearing fruit trees in the county, as reported by the Federal census, are given in table 2.

TABLE 2.—*Acreages of the principal crops and number of bearing fruit trees in Cumberland County, Tenn., in stated years* [1]

Crop	1879	1889	1899	1909	1919	1929	1939
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn for grain	8,452	7,700	9,144	7,968	8,753	7,272	11,915
Oats threshed	1,366	2,170	391	255	95	26	135
Wheat	517	224	460	195	162	59	326
Rye	786	465	264	149	72	-------	85
Hay, total	568	2,858	4,712	2,798	10,508	11,236	14,907
Clover or timothy, alone or mixed	-------	-------	-------	1,608	1,765	3,701	3,017
Clover alone	-------	-------	207	-------	255	456	[2] 30
Alfalfa	-------	-------	20	-------	18	11	35
Annual legumes for hay	-------	-------	-------	-------	2,799	1,594	836
Small grain hay	-------	-------	1,538	407	2,212	1,375	625
Lespedeza	-------	-------	-------	-------	-------	-------	6,304
Other tame hay	-------	-------	2,696	-------	1,841	3,738	3,576
Wild hay	-------	-------	451	783	1,618	361	484
Silage	-------	-------	-------	-------	71	22	26
Coarse forage	-------	-------	402	483	3,662	224	274
Sorghums cut for silage, hay, or fodder	-------	-------	-------	-------	-------	34	71
Sorghums harvested for sirup	-------	179	161	317	358	84	116
Potatoes	-------	469	572	710	744	847	1,379
Sweetpotatoes	134	102	112	148	195	174	277
Vegetables harvested for sale	-------	-------	-------	344	102	36	32
Tobacco	15	23	36	12	10	8	22
Strawberries	-------	-------	5	7	3	11	19
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Apples—trees	-------	46,213	61,215	66,253	35,670	24,964	30,613
Peaches—do	-------	4,475	5,621	10,125	9,945	9,575	7,815
Pears—do	-------	286	335	1,608	830	532	714
Plums—do	-------	582	575	1,432	947	721	684
Cherries—do	-------	875	559	1,362	1,873	1,416	1,711
Grapes—vines	-------	-------	4,772	2,246	3,747	2,448	5,495

[1] Fruit trees are for the census years 1880–1940.
[2] Sweetclover.

The total value of all crops harvested increased from $344,242 in 1909 to $1,092,550 in 1919, then decreased to $620,235 in 1929, and again increased slightly in 1939 to $650,097. The high value in 1919 is partly explained by the comparatively high prices obtained at that time. The values of certain agricultural products by classes in 1909,

1919, 1929, and 1939, as reported by the Federal census, are given in table 3.

TABLE 3.—*Value of certain agricultural products, by classes, in Cumberland County, Tenn., in stated years*

Product	1909	1919	1929	1939
Cereals	$83,776	$328,547	$159,483	$203,814
Other grains and seeds	849	11,734	1,283	592
Hay and forage	78,049	392,946	206,662	175,519
All vegetables	79,993	309,978	172,113	238,735
For sale [1]	(2)	(2)	3,248	1,652
For farm households' use [1]	(2)	(2)	62,949	130,287
Potatoes and sweetpotatoes	(2)	(2)	105,916	106,796
Fruits and nuts	23,920	29,599	18,921	19,326
Horticultural specialties sold	(2)	(2)	30	6,050
All other crops	77,655	19,746	5,412	6,061
Forest products sold	(2)	(2)	56,331	11,422

[1] Excluding potatoes and sweetpotatoes.
[2] Data not available

The value of all farm products sold, traded, or used by farm households was $750,139 in 1939 and $652,431 in 1929. The values of the products by source of income in 1939 are given below:

Crops sold or traded	$75,253
Forest products sold	11,422
Livestock sold or traded [1]	108,967
Livestock products sold or traded:	
Dairy products	15,998
Poultry and poultry products	28,285
Other livestock products	7,118
Total farm products sold or traded	247,043
Farm products used by farm households	503,096
Total farm products sold, traded, or used	750,139

[1] Excluding poultry, bees, and fur animals.

TILLING, PLANTING, AND HARVESTING

Tillage practices on the Cumberland Plateau part of the county vary from farm to farm, depending on the implements, number of work animals, labor supply, managerial ability of the farmer, and a number of other factors. In general, a disk harrow is used on freshly cleared land and turnplows for plowing under sod crops. Land on which intertilled crops have been grown is generally disked rather than turned. Most farmers use a spike-tooth harrow in preparing the seedbed after the land has been disked or turned. A double-shovel plow is commonly used to cultivate row crops. Corn is planted either with a single-row planter or by hand. Potatoes grown on a small scale are planted by hand, but on a large scale mostly by potato planters.

In harvesting, most of the corn is topped and snapped, and a small part is cut and shocked. Most of the small grain is cut with a cradle, as very few binders are in the county. A few of the large-scale potato growers use diggers and employ modern methods in harvesting.

The dates of planting and harvesting crops are given in table 4.

TABLE 4.—*Planting and harvesting dates of specified crops in Cumberland County, Tenn. (10)*

Crop	Date of planting	Approximate date or range of dates of harvesting
Corn	May 4–20	Oct. 1.
Oats:		
Spring	Mar. 15–30	July 1.
Winter	Sept. 1–30	June 10.
Wheat	Oct. 1–10	June 20.
Rye	Sept. 15–Oct. 5	June 20.
Red clover	Mar. 15–30	June 1 and Sept. 1.
Lespedeza	Mar. 15–Apr. 15	July 1–Sept. 1.
Potatoes	Mar. 1–Apr. 1	July 1–30.
Do	June 15–July 1	Oct. 1–15.
Sweetpotatoes	May 5–30	(1)
Beans, bush	Apr. 30–Aug. 1	July 1–Aug. 1.
Beets	Mar. 15–Apr. 15	July 15.
Tomatoes	May 15–30	July 20–Sept. 30.
Watermelons	May 15–30	Aug. 10.

[1] Before killing frost.

ROTATIONS AND FERTILIZERS

Rotations practiced on the Cumberland Plateau are variable, the most common consisting of corn for 2 years followed by lespedeza for 2 years. A few farmers seed a cover crop of crimson clover in the corn, or other row crops, to be turned under for green manure. If potatoes are grown, a common rotation includes the following: Potatoes followed by corn, and after the corn, lespedeza for 2 years. The county agricultural agent has recommended small grains for use in this rotation. Even though the yields of small grains are generally low, such crops afford a winter cover for the land. A few farmers grow corn on the same land for 3 years or more in succession, after which they rest the land for a few years. During this resting or idle period, the land is grown over with weeds and shrubs.

In 1939 (1940 census), 1,423 farms reported the purchase of commercial fertilizer. The total amount spent for this purpose increased from $240 in 1889 to $37,720 in 1939, and the proportion of farms using it increased from 46.3 percent in 1909 to 69.0 percent in 1939. Most of the fertilizer is factory mixed. Fertilizers generally used for corn include the 4–10–4 [5] and 0–16–0 grades, and for potatoes, the 3–8–4 grade. Lime is used on many of the farms, especially on those near towns or on good roads. Some farms are so far from the source of supply and on such poor roads that the cost of delivery is very high. Records of the county agricultural agent show that 22,000 tons of lime were applied to the land in 1937 and 1938, exclusive of that used on the Cumberland Homesteads. The use of phosphatic fertilizers is rapidly expanding.

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

PERMANENT PASTURE

Permanent pasture occupies a relatively small total acreage. A large part is in Sequatchie Valley and Grassy Cove and is mainly on Rolling stony land (Talbott soil material). Pasture plants consist largely of bluegrass and white clover, and the pasturage is of excellent quality. A very small acreage of permanent pasture is on the Cumberland Plateau part of the county. Nearly all the forested land in the county is grazed, but it sustains rather scant pasturage.

LIVESTOCK AND LIVESTOCK PRODUCTS

Livestock on farms in the county consists chiefly of cattle, swine, sheep, and chickens. Census data show that the number of cattle of all ages decreased from 8,085 in 1920 to 6,164 in 1930, but that the number over 3 months old on April 1, 1940, was 7,019. Most of the dairy cattle are grade Jersey and Guernsey. In 1939, 2,448 cows and heifers were milked on 1,476 farms, and of the 881,230 gallons of milk produced, 48,052 gallons were sold as whole milk and 801 pounds as butterfat. Of the 190,185 pounds of butter churned, 17,346 were sold. Nearly all dairy products are consumed within the county. A few dairy farms located near Crossville supply the town with fresh milk. The cattle for beef consist mainly of grade and purebred Hereford, Aberdeen Angus, and Shorthorn. Grade Hereford is most common on the Cumberland Plateau and purebred Aberdeen Angus in Grassy Cove and Sequatchie Valley. Practically all the cattle secure most of their feed from open range.

The hogs consist of grade Hampshire, Poland China, and Duroc-Jersey. The number of swine of all ages declined from 12,619 in 1920 to 6,964 in 1930, but on April 1, 1940, there were 10,361 over 4 months old. Like the cattle, they get most of their feed from open range but generally are fed on corn before marketed. Practically all the hogs raised for sale are transported by truck to market in Cookeville, Knoxville, and Chattanooga.

Most of the sheep are grade Hampshire and Shropshire. On April 1, 1940, there were 5,971 sheep and lambs over 6 months old in the county, compared with 9,552 of all ages on April 1, 1930. They obtain most of their feed from open range. It is probable that sheep-killing dogs are the cause of the comparatively small number of sheep. Most of the lambs raised for sale are marketed in Cookeville, Knoxville, and Chattanooga. A total of 20,930 pounds of wool shorn was reported by 270 farms in 1939.

In 1939 (1940 census), 91,429 chickens raised and 233,921 dozen eggs produced were valued at $75,827. A total of 26,028 chickens was sold alive or dressed at $10,932. Most of the chickens are kept in small flocks on the farms, as there are very few poultry farms. The most popular breeds of chickens are the Plymouth Rock, Rhode Island Red, White Leghorn, and Buff Orpington. Nearly all the surplus eggs are bartered locally for groceries. During spring and early in summer there is an excess of eggs for local needs, but at other times it is often necessary to bring in eggs to supply local demands. Some turkeys, ducks, geese, and guineas are raised. Several farms have bees, and in 1939 a production of 9,475 pounds of honey was reported by 154 farms.

The work animals include both horses and mules, though there are somewhat more mules than horses. The total number of horses and mules of all ages decreased from 2,322 in 1920 to 1,815 in 1930, and on April 1, 1940, there were 2,153 over 3 months old. They average about 1 to the farm, and it is doubtful that the number is adequate. Not enough work animals are being raised on the farms to replace the present numbers.

A total of 13,396 animals, valued at $166,139, was sold or slaughtered on farms in 1939, of which 8,210 were hogs and pigs valued at $95,495, 2,928 were sheep and lambs at $16,104, and 2,258 were cattle and calves at $54,540. Animals purchased numbered 1,136 hogs and pigs, 750 cattle and calves, and 422 sheep, valued at $6,248, $17,074, and $2,110, respectively, totaling $25,432.

The number and value of livestock on farms in this county for the years 1920, 1930, and 1940, as reported by the Federal census, are given in table 5.

TABLE 5.—*Number and value of livestock on farms in Cumberland County, Tenn., in certain years*

Livestock	1920		1930		1940	
	Number [1]	*Value*	*Number* [2]	*Value*	*Number*	*Value*
Horses	1,087	$134,191	691	$43,998	[3] 965	[3] $86,482
Mules	1,235	176,768	1,124	100,313	[3] 1,188	[3] 136,170
Asses and burros	14	752	12	600		
Cattle	8,085	291,509	6,164	250,989	[3] 7,019	[3] 223,535
Swine	12,619	102,025	6,964	70,552	[4] 10,361	[4] 54,226
Sheep	7,280	63,448	9,552	58,212	[5] 5,971	[5] 33,318
Goats	571	1,961	438	1,159	[4] 162	[4] 290
Chickens	33,351	29,953	[3] 27,816	[3] 22,531	[4] 44,655	[4] 22,328
Other poultry	821		([6])	([6])	[4] 541	[4] 420
Bees—hives	2,838	12,718	1,736	5,816	1,067	2,401
Total value		813,325		554,170		559,170

[1] All ages on January 1.
[2] All ages on April 1, except chickens over 3 months old.
[3] Over 3 months old on April 1.
[4] Over 4 months old on April 1.
[5] Over 6 months old on April 1.
[6] Not available.

The value of certain livestock products on farms for the years 1909, 1919, 1929, and 1939, as reported by the Federal census, is given in table 6.

TABLE 6.—*Value of certain livestock products by classes in Cumberland County, Tenn., in stated years*

Livestock products	1909	1919	1929	1939
Whole milk, cream, and butter sold	$7,155	$8,088	$18,983	$14,737
Whole milk	([1])	([1])	8,850	10,571
Cream [2]	([1])	([1])	4,116	176
Butter	([1])	([1])	6,017	3,990
Poultry raised and chicken eggs produced	27,870	86,446	92,989	76,257
Animals sold and slaughtered	190,488	([1])	([1])	166,139
Cattle and calves	([1])	([1])	([1])	54,540
Hogs and pigs	([1])	([1])	([1])	95,495
Sheep and lambs	([1])	([1])	([1])	16,104
Wool shorn	[3] 6,240	9,979	[4] 7,605	5,023
Honey produced	[5] 580	[5] 10,251	3,670	1,232

[1] Data not available.
[2] Sweet cream and sour cream (butterfat).
[3] Including mohair.
[4] Including mohair and kid.
[5] Including wax.

TYPES OF FARMS

According to the classification of farms by major source of income in 1939 (1940 census), of the 2,063 farms in the county, 1,849 (89.6 percent) are the subsistence type, or farms on which a large part of the farm products is consumed; 59 (2.9 percent) derive their major source of income from livestock sold or traded; 31 (1.5 percent), from field crops sold or traded; 9 (0.4 percent), from forest products sold; 8 (0.4 percent), from poultry and poultry products sold or traded; and 6 (0.3 percent), from dairy products sold or traded. In addition, there were 59 farms with no farm products sold, traded, or used and 39 unclassified farms.

LAND USE

The population of the county increased from 4,538 in 1880 to 15,592 in 1940, according to the Federal census, and with this increase there was a decided change in the number, total acreage, and size of farms. The number increased from 715 to 2,063, but the total acreage in farms decreased from 41.8 to 29.7 percent and the size from 205.1 acres in 1880 to 62.5 acres in 1940. Although the farms are much smaller, the acreage of improved land to the farm did not change significantly. All land in farms in 1940 comprised 128,874 acres, 39.4 percent of which was improved.

The change in the use of land for forest to use for crops has been gradual between 1880 and 1940, and a very large part of the land is still in forest. There has been a considerable change in the crops grown, a greatly increased acreage being used for hay and forage crops, especially lespedeza, and also for potatoes and sweetpotatoes. The acreage used for small grains decreased rapidly during the same period.

In 1939 (1940 census), 50,722 acres were available for crops, including plowable pasture, and crops were harvested from 31,318 acres. Of this total, 11,915 acres were in corn harvested for grain; 14,907 acres in all hay, exclusive of sorghums; and 1,379 acres in potatoes. Of the total area in farms, 10,532 acres were in plowable pasture and 71,908 in woodland. The nonfarm land consists almost wholly of cut-over forest. The farm land according to use in 1929 and 1939, as reported by the Federal census, is given in table 7.

TABLE 7.—*Farm land according to use in Cumberland County, Tenn., in 1929 and 1939*

Land use	1929	1939
	Acres	*Acres*
Land available for crops (harvested, failure, idle or fallow, and plowable pasture)	29,548	50,722
Cropland harvested	20,940	31,318
Crop failure [1]	373	782
Cropland, idle or fallow	4,765	8,090
Plowable pasture	3,470	10,532
Woodland [2]	47,982	71,908
All other land in farms [3]	6,282	6,244
Total land in farms	83,812	128,874

[1] Land from which no crop was harvested because of destruction from any cause, or failure to harvest because of low prices or lack of labor.

[2] All farm woodland or timber tracts, natural or planted, and cut-over land with young growth, which has or will have value as wood or timber.

[3] Including pasture land other than plowable and woodland pasture, all wasteland, house yards, feed lots, lanes, and roads.

In 1940 the farms of the county ranged in size from less than 10 acres to more than 1,000, 920 containing less than 10 acres to 29; 953, 30 acres to 139; and 190, 140 acres to more than 1,000. The size range of farms, number of farms, and land in farms in 1940 and acreage of cropland harvested in 1939, by size of farm, as reported by the 1940 Federal census, are given in table 8.

TABLE 8.—*Number of farms and farm acreage, 1940, and cropland harvested, 1939, by size of farm, in Cumberland County, Tenn.*

Size of farms (acres)	Number of farms	Land in farms		Size of farms (acres)	Number of farms	Land in farms	
		Total	Cropland harvested			Total	Cropland harvested
		Acres	*Acres*			*Acres*	*Acres*
Under 10	292	1,630	803	180–219	41	8,154	1,206
10–29	628	10,958	4,586	220–259	24	5,681	1,134
30–49	327	12,403	4,069	260–379	28	8,692	1,183
50–69	289	15,881	4,796	380–499	11	4,667	711
70–99	185	15,156	4,070	500–699	10	5,710	475
100–139	152	17,002	4,205	700–999	7	5,303	700
140–179	63	9,637	2,332	1,000 and over	6	8,000	1,048

The number of farms, proportion of land in farms, average size of farms, proportion and average acreage of improved land in farms, and the population of the county in the census years 1880–1940 are given in table 9.

TABLE 9.—*Farms, acreages, and population in Cumberland County, Tenn., in stated years*

Year	Population of county	Farms	Area in farms		Improved land in farms	
			Proportion of county	Average size of farm	Proportion of farm land	Average per farm
		Number	*Percent*	*Acres*	*Percent*	*Acres*
1880	4,538	715	41.8	205.1	10.8	22.2
1890	5,376	800	40.0	175.5	15.1	26.6
1900	8,311	1,035	43.5	147.3	15.8	23.5
1910	9,327	1,198	28.0	98.0	21.8	21.4
1920	10,094	1,267	28.7	95.0	25.7	24.4
1930	11,440	1,034	20.0	81.1	35.3	28.6
1940	15,592	2,063	29.7	62.5	39.4	24.6

FARM TENURE

In 1940 the Federal census reported 1,529 farms, or 74.1 percent of the total, operated by full owners; 96, or 4.7 percent, by part owners; 435, or 21.1 percent, by tenants; and 3, or 0.1 percent, by managers.

Tenancy here is not so common as in some other counties of the State. The percentage of tenancy decreased from 23.5 in 1880 to 16.3 in 1930 but rose to 21.1 in 1940. The proportion of tenancy for the State in 1940 was 40.3 percent. Managers have operated only a few farms. Of the 435 tenant-operated farms in 1940, 113 were operated by share tenants and croppers, 87 by cash tenants, 2 by share-cash tenants, and 233 by other tenants. Three systems of share rental are practiced: (1) The tenant furnishes the labor and a third

of the fertilizer, and receives a third of all the crops; (2) the tenant furnishes the labor, tools, work animals, and half the seed and fertilizer, and receives half of all the crops; and (3) the tenant clearing the land of forest receives for the first 2 years all the crops grown on the land cleared.

All land in farms operated by full owners in 1940 was 96,733 acres; by part owners, 6,903 acres; and by managers, 1,878 acres. Of the 23,360 acres of farm land operated by tenants, 3,287 acres were operated by cash tenants, 8,765 by share-cash tenants and by share tenants and croppers, and 11,308 acres by other tenants. Cropland harvested in 1939 by full owners was 24,593 acres; by part owners, 1,819 acres; by managers, 327 acres; and by tenants, 4,579 acres.

The amount spent for farm labor increased from $9,600 in 1899 to $43,736 in 1939, according to the Federal census. Wage levels are subject to change by changing economic conditions. The supply of farm labor ordinarily is adequate. Of the amount paid for labor in 1939, $6,665 was for labor hired by the month on 31 farms, $34,507 for labor hired by the day or week on 490 farms, and $2,564 for other hired labor, including piece work and contract labor, on 34 farms.

In 1939, 1,030 farm operators, or 49.9 percent of the total, reported work off their farms for pay or income for a total of 161,634 days, or an average of 157 days each. The number who reported no days worked off their farms in 1939 was 851, and the number not reporting was 182. Of the farm operators reporting, 1,938 reported that residence on April 1, 1940, was on the farm operated, and 47 reported that residence was not on the farm operated.

FARM INVESTMENT AND EXPENDITURE

In the 1940 census the total value of all farms (land and buildings) was $2,707,112, of which $1,231,178 was the value of buildings on 2,042 farms. The average value of land and buildings a farm was $1,312, or $21.01 an acre, and of farms of 30 acres or more, $1,756 a farm. In 1880 the value of all property per farm (land and buildings, implements and machinery, and livestock) was $709, of which 68 percent was in land and buildings, compared with $1,688 and 77.7 percent, respectively, in 1940. The percent of value of all farm property in 1940 in implements and machinery was 6.2 and in livestock 16.1.

The value of farms (land and buildings) operated by full owners in 1940 was $2,025,368; by part owners, $141,576; by managers, $27,000; and by tenants, $513,168. The value of buildings on the 1,516 farms operated by full owners was $922,525; on the 96 farms operated by part owners, $70,198; on the 3 farms operated by managers, $8,000; and on the 427 farms operated by tenants, $230,455.

The value of implements and machinery on the 1,060 farms operated by full owners in 1940 was $177,805; on the 80 farms operated by part owners, $12,200; on the 3 farms operated by managers, $4,260; and on the 194 farms operated by tenants, $20,906.

In 1939 a total expenditure of $48,421 for feed for domestic animals and poultry was reported for 1,047 farms, compared with $43,200 for 697 farms in 1909. A total of $91,328, however, was spent for feed in 1919 on 794 farms, which may be explained by the higher prices for feed in 1919.

In 1939 (1940 census) farm expenditures for wages, feed, commercial fertilizer, liming materials, implements and machinery, motor fuels, and building materials amounted to $230,660. These expenditures and the number of farms reporting are given in table 10.

TABLE 10.—*Specified farm expenditure and farms reporting such expense in Cumberland County, Tenn., in 1939*

Items of expenditure	Farms reporting	Amount spent
Cash wages paid for hired labor [1]	541	$43,736
Feed for domestic animals and poultry	1,047	48,421
Commercial fertilizer	1,423	37,720
Liming materials	133	5,156
Implements and machinery [2]	282	44,770
Gasoline, distillate, kerosene, and oil	691	20,191
Building materials [3]	414	30,666

[1] Exclusive of housework and contract construction work.
[2] Including expenditures for automobiles, tractors, and motortrucks.
[3] Including lumber, roofing materials, hardware, cement, paint, fencing material, etc., for use on the farm.

In general, the farms of the county are equipped with the following implements: A 10-inch turnplow, an 8-disk harrow, a bull tongue, a double-shovel cultivator, a "gee whizz" spring cultivator, and a wagon. There are a single-row corn planter, mowing machine, and hay rake to about every three farms. A few farms have tractors and equipment. Several farmers have small trucks for use on the farm and for other driving. In 1940, 414 farms had 420 automobiles, 204 had 206 motortrucks, and 23 had 27 tractors.

SOIL SURVEY METHODS AND DEFINITIONS

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

The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings made, and highway or railroad cuts and other exposures studied. Each exposes a series of distinct soil layers, or horizons, termed collectively the soil profile. Each horizon, as well as the underlying parent material, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The chemical reaction of the soil and its content of lime and salts are determined by simple tests.[6] Other features taken into consideration

[6] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

	pH value
Extremely acid	Below 4.5
Very strongly acid	4.5–5.0
Strongly acid	5.1–5.5
Medium acid	5.6–6.0
Slightly acid	6.1–6.5
Neutral	6.6–7.3
Mildly alkaline	7.4–8.0
Strongly alkaline	8.1–9.0
Very strongly alkaline	9.1 and higher

are the drainage, both internal and external, the relief, or lay of the land, and the interrelations of soil and vegetation.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon the features that influence the adaptation of the land to the production of crop plants, grasses, and trees. On the basis of these characteristics the soils are grouped into classification units, the principal three of which are (1) series, (2) type, and (3) phase. Some areas that have no true soil—rolling stony land and rough stony land—are termed (4) miscellaneous land types.

The series is a group of soils having the same genetic horizons, similar in their important characteristics and arrangement in the profile and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage, and other important internal characteristics and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The series are given geographic names taken from localities near which they were first identified. Hartsells, Muskingum, Crossville, and Talbott are names of important soil series in Cumberland County.

Within a series are one or more types, defined according to the texture of the upper part of the soil. Thus, the class name of this texture—sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, or clay—is added to the series designation to give a complete name to the soil type. Hartsells silt loam and Hartsells fine sandy loam are soil types within the Hartsells series. Except for the texture of the surface soil, these types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the unit to which agronomic data are definitely related. In comparisons of the type and phases of that type, to avoid the repetition of their complete names, the type is sometimes referred to as the normal phase.

A soil phase specifically named is a variation within the type, differing from the normal phase of that type in some minor feature, generally external, that may be of special practical significance. For example, within the normal range of relief of a soil type some areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Differences in relief and degree of accelerated erosion may be shown as phases. Even though no important differences may be apparent in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such instances the more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. Dewey silt loam, rolling phase, is an example of a phase in the Dewey series.

Rolling stony land (Muskingum soil material) and Rough stony land (Talbott soil material) are examples of miscellaneous land types.

Texture refers to the relative quantities of clay, silt, and various grades of sand making up the soil mass. Light-textured soils contain much of the coarser separates (sands), and heavy-textured ones much clay. Structure refers to the natural arrangement of the soil material

into aggregates, or structural particles or masses; and consistence, to such conditions as friability, plasticity, stickiness, hardness, compactness, toughness, and cementation. Permeability and perviousness connote the ease with which water, air, and roots penetrate the soil.

Ordinarily the surface soil refers to the lighter textured surface layer extending usually to a depth of 6 to 12 inches. The subsoil is the deeper and heavier textured layer that is usually of a uniform color in well-drained soils. The substratum, beneath the subsoil, is characteristically splotched or mottled with two or more colors. Bedrock, as used here, is consolidated rock on which the substratum rests.

Acidity is the degree of poverty in lime (available calcium), or the quantity of lime that should be applied for certain crops. In this county an alkaline soil is rich in available calcium, and a neutral soil contains enough for any crop commonly grown.

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

The term "workability" refers to the ease with which tillage, harvesting, and other farming operations can be performed. Six descriptive terms used are, in decreasing order of ease of performance of farming operations, excellent, very good, good, fair, poor, and very poor. Soils of excellent workability are suitable for the use of all common kinds of farm machinery with minimum effort; those of very good workability are suited to all common types of farm machinery, but some features, as heavy texture, small quantities of stones or pieces of gravel, or somewhat uneven but mild slopes, make their use more difficult than on the excellent soils; those of good workability are suited to all common kinds of farm machinery, but their use requires more effort than on the very good; those of fair workability are poorly suited to the use of heavy farm machinery; those of poor workability are not suited to the use of heavy farm machinery, and all types of heavy machinery are used with great difficulty; those of very poor workability can generally be tilled only with hand implements.

The term "conservability" refers to the ease with which soil productivity and workability can be maintained or improved. Major factors considered in the use of this term are ease of conservation of soil material, plant nutrients, and good tilth. The conservability of a soil is described as excellent, very good, good, fair, poor, or very poor. In general, excellent, very good, good, or fair used in reference to soil conservability indicates feasible use in most places of the soil for crops requiring tillage, whereas poor or very poor indicates that conservability is too difficult in most places for the feasible use of the soil for tilled crops.

The term "productivity" refers to the capacity of a soil to produce crops under the prevailing practices of farming. A soil may be productive of a crop but may not be well suited to it because of poor workability or conservability, or both. The same terms are used in describing productivity as were used for conservability.

SOILS

Soil and land conditions have determined to some degree local differences in the present agriculture of Cumberland County. Social and economic factors also have been an influence in the agriculture, but local variations in these factors are governed by soil and land conditions.

For example, soil and land conditions in Grassy Cove are favorable for the production of corn and pasture, which, in connection with livestock raising, dominate the agriculture of this part of the county. The dominant soils of Sequatchie Valley are inherently productive, and some of them are well suited to pasture and most of the others are well suited to many different crops; consequently, a widely diversified agriculture, including all the kinds of crops grown in the county, has become established here, together with some specialization in livestock production. As the soils of Grassy Cove and Sequatchie Valley are generally productive and easily cultivated, they support the larger farms and produce better economic and social conditions. These soils, however, cover only a small part of the county.

Most of the soils of the county are uniform in color, texture, structure, natural fertility, and parent material. About 95 percent of them have formed in place from weathered material of sandstone and shale, principally sandstone, about 2 percent from weathered material of limestone or from transported material derived principally from weathered limestone, and about 3 percent from transported material derived chiefly from weathered sandstone.

In more than 95 percent of the county the soils in their virgin condition are low in content of phosphate, lime (7), organic matter, and possibly other constituents necessary to proper plant growth. The depth to bedrock, averaging less than 40 inches, is shallow compared with that in some other parts of the State. The texture and other physical properties are conducive to good tilth in most places and consequently are favorable to farming operations. Under good practices of management, including the use of lime, phosphate, and winter cover crops, these soils may be made moderately productive.

The texture of the soils is prevailingly fine, about 88 percent being fine sandy loam, and the rest very fine sandy loam, loam, silt loam, and silty clay loam.

Although most of the soils are similar in many respects, they differ widely in suitability for use. The depth to bedrock ranges from a few inches to about 72 and the slope in gradient from almost none to more than 30 percent. In some areas there are no stones, but in many others the soils are stony to very stony. The use of the soils for general agriculture, therefore, depends largely on depth of soil to bedrock, slope, and stoniness. Thus, a soil of 4-percent slope and otherwise favorable can be used for cropland, whereas a soil of 30-percent slope, although practically the same in all other respects, is best used for forest, because of susceptibility to erosion and difficulty of cultivation. Shallowness of the profile to bedrock and stoniness also affect the use suitability of soils.

More than half the soils are nonarable because of one or a combination of unfavorable features. An estimate shows that 50.7 percent of the soils are unsuited to crop use chiefly because of a combination

of strong relief and stoniness, 7.4 chiefly because of a combination of stoniness and shallowness of profile to bedrock, 2.3 because of strong relief, and 0.6 because of the shallowness of the profile to bedrock. About 1 percent of the soils require artificial drainage before they can be used for cultivated crops. Of the soils of the county, 22 percent have slopes of 5 percent or less and are relatively stone-free, or not stony enough to interfere materially with cultivation.

Except the Huntington and Dunning soils, all the soils are medium to very strongly acid. Only a small percentage of them have been severely eroded, which for the most part is owing to the fact that a very large part of the county has never been cleared of forest. In the older cleared areas in Grassy Cove and Sequatchie Valley some of the fairly gentle slopes have been moderately eroded, but most of the land of steep slope has been severely eroded by sheet and gully erosion.

SOIL SERIES AND THEIR RELATIONS

Soils of 17 soil series are mapped in the county. Some are of relatively little importance in the agriculture because of small extent, unfavorable use suitability, or both. Knowledge of the soil series, especially of those that represent important soils, will be useful in interpreting the results of this survey. Such knowledge can be acquired more readily by associating the soil series with prominent land features.

For this purpose, the soil series are grouped in relation to the major land features as follows: Those on (1) uplands, (2) colluvial lands, (3) stream terraces, and (4) bottom lands. Uplands are those lands elevated above adjacent lowlands and underlain by weathered material of the underlying rocks. Colluvial lands lie at the foot of slopes on the uplands and contain soil derived from accumulations of materials that washed or sloughed from the slopes above. Stream terraces are water-made benches that border stream bottoms but occupy higher positions and are not subjected to flooding. Bottom lands derived from water-borne material are on first bottoms near streams and are subjected to flooding. The soil series associated with each of these prominent features of the landscape and the main characteristics of each series are shown in table 11.

SOILS OF UPLANDS

Nearly all the soils of the uplands have formed from weathered products of interstratified sandstone and shale, mainly sandstone, but a few of them have formed from weathered material of limestone or dolomitic limestone. These soils have slow to rapid external drainage and medium to slow internal drainage, although internal drainage is very slow in the soil of the Lickdale series. They differ widely in profile characteristics, use suitability, and productivity.

Some of these soils are on the sandstone plateau; others are in limestone valleys and coves; but those on the plateau are by far the more extensive. Members of the Hartsells, Crossville, Johnsburg, Lickdale, Muskingum, and Hector series occur on the sandstone plateau. The first four occupy areas of mild relief and the last two areas of hilly and steep relief. All are comparatively shallow to bedrock. Members of the Dewey and Talbott series are in the limestone valleys

and coves. Soils of the Dewey series have formed from weathered material of high-grade limestone or high-grade dolomitic limestone. The depth of the profiles to bedrock is comparatively great, and the relief is prevailingly undulating and rolling. Soils of the Talbott series have formed from residual material of weathered argillaceous limestone or dolomitic limestone. The depth of the profile to bedrock is generally less than that of the Dewey soils. The relief ranges from gently undulating to steep. Some chert fragments are on the surface and in the profile in places, and a few outcrops of bedrock occur.

HARTSELLS SERIES

Soils of the Hartsells series are on gently undulating to rolling parts of the Cumberland Plateau, associated with those of the Crossville, Johnsburg, and Lickdale series, which also occur on the smoother parts of this plateau, and with those of the Muskingum and Hector series on the steeper parts. The soils have grayish-yellow or pale-yellow surface soils and yellow or brownish-yellow subsoils. Underlying the subsoil is generally a relatively thin layer of yellowish-gray sand. Horizontally bedded sandstone bedrock underlies the soil profile at a depth of 18 to 60 inches, but in most places it occurs at a depth of about 36 inches.

The Hartsells series is represented by two types and four phases as follows: Hartsells fine sandy loam and its rolling, deep, and shallow phases; and Hartsells silt loam and its rolling phase. This extensive series occupies a total of 147,360 acres distributed in all parts of the county, but the main areas are northeast of the Crab Orchard Mountains.

A large part of this series is in forest, consisting mainly of oak, hickory, and pine. The cleared land is used principally for corn, hay, and pasture and some potatoes and other vegetables. Wheat, oats, and rye are grown to a small extent on some of the soils.

CROSSVILLE SERIES

Similar in many respects to the soils of the Hartsells series, the Crossville soils have been formed chiefly from weathered products of sandstone and occur in gently undulating to rolling areas on the Cumberland Plateau. They differ from the Hartsells soils in being browner throughout the profile and, in general, in being shallower to bedrock. Usually, these soils are well drained, though small seepy places occur here and there. They have dark grayish-brown to brown friable mellow surface soils and grayish-brown to yellowish-brown friable subsoils. Beneath the subsoil is grayish-brown or brownish-gray fine sandy loam material containing many small fragments of sandstone. Sandstone bedrock, which is horizontally bedded, lies at a depth of 10 to 50 inches but in most places at a depth of about 30 inches.

The suitability of these soils for agricultural use depends to a large extent on their depth to bedrock and to a less extent on their stoniness and relief. Where the depth to bedrock is more than 18 inches and stones are not too numerous, the soils are well suited to most of the crops commonly grown. Where the depth to bedrock is less than 18 inches, the soils dry out readily, are easily eroded, and their suitability for crop or pasture use is somewhat limited.

Members of the Crossville series are mapped in two types and two phases as follows: Crossville loam and its rolling and shallow phases and Crossville stony loam. These soils have a total area of 29,912 acres.

Probably 95 percent of the area is in oak and pine forest. The cleared land is used mainly for corn, hay, and pasture. Wheat, oats, rye, and sorghum are minor crops, and potatoes and other vegetables are grown to some extent. Apparently, the Crossville soils are a little better suited to corn, hay, and pasture than the Hartsells but are not so well suited to potatoes and other root crops.

JOHNSBURG SERIES

Occurring in nearly level to level or slightly depressed positions on the Cumberland Plateau, the soil of the Johnsburg series is imperfectly drained and, although not subject to overflow by streams, is waterlogged in the lower part most of the time. The parent material consists of weathered products of sandstone and shale, but local alluvial and colluvial materials derived from soils on the uplands apparently have contributed to its formation. This soil has dark-gray to grayish-yellow smooth mellow surface soil and pale-yellow friable subsoil. Below the subsoil is mottled yellow, gray, and brown slightly compact soil material.

Johnsburg very fine sandy loam, the only member of the series mapped in the county, occupies 394 acres. About a third of it has been cleared and is used mainly for corn, hay, and pasture. Post oak, black tupelo (blackgum), and red maple trees compose the main growth on the uncleared land.

LICKDALE SERIES

The poorly drained soil of the Lickdale series occurs in nearly level to level or slightly depressed places on the Cumberland Plateau. It has been formed from weathered material of the underlying sandstone and shale rocks, together with materials washed or sloughed from soils on the adjacent slopes. The dark-gray to nearly black mellow surface soil has a high content of organic matter. The slightly compact subsoil is mottled grayish yellow, brown, and gray. Beneath the subsoil is gray soil material, mottled with yellow, blue, and brown.

Lickdale silt loam, the only member of the Lickdale series mapped in the county, has an area of 504 acres. A large part of it has been cleared and is used principally for hay and pasture because poor drainage prevents the use of the soil for cultivated crops in most places.

MUSKINGUM SERIES

The well to excessively drained soils of the Muskingum series are on the Cumberland Plateau. The relief is predominantly hilly and steep, though over a rather large part of the total area it is undulating to rolling. Loose rock fragments are on the surface and in the profile over most of the soil area; outcrops of bedrock appear here and there. Soils of this series are derived from sandstone interstratified with some shale. In general, they have weakly developed profiles and grayish-yellow or yellowish-gray friable surface soil and yellow friable subsoil. The material underlying the subsoil consists of light-

yellow soft decomposed rock mixed with many small fragments of sandstone. The depth of the profile to bedrock is extremely variable, ranging from 6 to 60 inches within short distances; in most places, however, the depth is about 28 inches.

The soils of the Muskingum series are the most extensive in Cumberland County, their aggregate area being 206,398 acres. The members are Muskingum fine sandy loam and Muskingum stony fine sandy loam with its undulating and steep phases. These soils occur in all parts of the county and are associated chiefly with Hartsells and Crossville soils. The stony fine sandy loam is the most extensive member and also the most extensive soil type in the county.

Practically all the soils of this series are in forest, consisting mainly of oak, pine, and some hickory. The rather small acreage of cleared land is used chiefly for hay, corn, and pasture, although wheat, rye, and potatoes are grown to a small extent. Some of the land once cleared is now grown over with trees.

It is estimated that 8 percent of the Muskingum soils are undulating, 78 percent hilly, and 14 percent steep. The hilly soils are considered to be typical. On mild relief the soil is suitable for pasture if liming, fertilization, and other needed management are practiced and other factors of production are considered. Where the relief is strong, the soil is unsuitable for crops and in most places poorly suitable for pasture—the most feasible use for such soil is forest.

HECTOR SERIES

Associated with the Muskingum series on the Cumberland Plateau, the inextensive soils of the Hector series cover an aggregate area of only 1,603 acres. They are hilly to steep, stony, variable in depth to bedrock, and excessively drained. Both the grayish-brown or grayish-yellow surface soil and the brown, red, or yellowish-red subsoil are friable. The subsoil is underlain by reddish-yellow friable fine sandy loam material containing many small fragments of sandstone. In most places the sandstone bedrock lies at a depth of 30 to 36 inches. The red or reddish color of the subsoil distinguishes the Hector soils from the Muskingum that has yellow subsoil.

Most of Hector stony fine sandy loam and its steep phase is in forest, mainly near Crab Orchard and Grassy Cove. The small part in cleared land is used for crops and pasture, but a few cleared areas have been allowed to grow up with trees.

DEWEY SERIES

The Dewey soils, formed from high-grade limestone or high-grade dolomitic limestone, are in the limestone belts of the county associated with soils of the Talbott and Emory series. These medium- to well-drained soils occupy positions on undulating and rolling uplands. The original forest consisted mainly of oak, hickory, chestnut, walnut, and maple trees.

The soils have grayish-brown to light-brown mellow surface soil and red, brownish red, or pale-red firm but friable subsoil. Beneath the subsoil the material consists of reddish-yellow silty clay, splotched with yellow, red, and gray. Bedrock generally occurs at a depth

of 15 to 20 feet, but in some places it is at a much less depth and in a few places outcrops.

The Dewey series is represented by Dewey silt loam and its rolling phase. These two soils have a total area of 220 acres confined to Sequatchie Valley. Practically all these soils are cleared land used mainly for corn and hay. Small grains, tobacco, and vegetables are grown on a relatively small total acreage.

TALBOTT SERIES

Occupying positions on undulating, rolling, hilly, and steep uplands in limestone valleys and coves, the soils of the Talbott series are associated with those of the Dewey, which they somewhat resemble. They differ, however, in being more sticky and plastic, in having shallower surface soil, subsoil, and substratum, and a more angular structure in the subsoil. They are also more susceptible to accelerated erosion, have been eroded more, and are less productive of most of the common crops. They have formed from clayey limestone.

These soils are well to excessively drained externally and medium to slowly drained internally. Outcrops and loose fragments of limestone are common; fragments of chert are generally numerous on hilly and steep areas. The Talbott soils have grayish-brown mellow surface soil, except where eroded. The subsoil is pale-red and slightly compact silty clay in the upper part and yellowish-red, tight, tough, and plastic silty clay in the lower; both parts are characterized by firm nut structure. The substrata consist of mottled yellow, red, gray, and brown, tough, tight, and plastic silty clay material composed of comparatively large structural aggregates. The depth of the profile to bedrock is variable but in most places is about 5 feet.

The Talbott series is represented by Talbott silt loam and Talbott silty clay loam with its eroded hilly and eroded steep phases. The total area is 1,828 acres. About 29 percent of the total area is undulating and rolling, 38 percent hilly, and 33 percent steep.

The suitability of these soils for different uses depends largely on the character of the slope and extent of accelerated erosion. Where not too severely eroded, soils of milder slope are suitable for most crops commonly grown in the county and for pasture. A forest, consisting mainly of deciduous trees, originally covered the Talbott soils. A large part of the undulating, rolling, and hilly land has been cleared and is used principally for hay, corn, and pasture. About half of the steep land has been cleared for crop use, but accelerated erosion has become so severe that the land not returned to forest is used chiefly for pasture. Corn and small grains are grown on a small acreage.

SOILS OF COLLUVIAL LANDS

The soils of the colluvial lands are members of the Jefferson and Emory series. Their parent material consists of soil material that sloughed or washed from higher slopes and accumulated on the lower ones. In places the parent material is composed of local alluvium. The material that gave rise to the Jefferson soils came from areas in which sandstone predominates, whereas the material that gave rise

to the Emory soil came from areas in which high-grade dolomitic limestone predominates.

In general, these soils are young in degree of development and have indistinct profiles, but in some places color profiles normal to the region have developed. They have mild relief, are well drained, and are friable throughout. Although differing in productivity, they are suited physically to the production of crops.

JEFFERSON SERIES

Soils of the Jefferson series occur on foot slopes of the Crab Orchard Mountains in Crab Orchard Gap, Grassy Cove, and Sequatchie Valley. These soils are gently sloping to strongly sloping and are well drained. They have formed mainly from colluvial materials washed from Muskingum and Hector soils and from the three land types of the stony land (Muskingum soil material). They have grayish-yellow friable loose surface soil and yellow friable sandy clay or fine sandy clay subsoil. The material beneath the subsoil is generally lighter textured than that of the subsoil and variable in color. Bedrock underlies the profile at a depth of about 4 feet to more than 20 feet.

The Jefferson series covers a total area of 697 acres classified and mapped in the county as Jefferson fine sandy loam and its slope phase. A large part of these soils is cleared land used mainly for corn, hay, and pasture; wheat, potatoes, and other vegetables occupy a small part.

EMORY SERIES

The soil of the Emory series occurs on foot slopes in limestone valleys and coves, where it has formed from local alluvial and colluvial materials washed chiefly from the two land types of the stony land (Talbott soil material). In some places the material has been washed from types and phases of the Dewey and Talbott soils.

The Emory soil has a mild relief and is well drained. The profile varies considerably in degree of development, but in most places it is immature. The soil has a brown to dark reddish-brown friable mellow surface soil and a reddish-brown, yellowish-red, or red firm friable subsoil, which contains a few chert fragments in many places. Below the subsoil the soil material is variable in color, texture, structure, and consistence.

Emory silt loam, the only member of the series mapped in the county, has an aggregate area of 168 acres. Practically all of it is cleared land used principally for corn, but hay, wheat, and other crops are grown to a small extent.

SOILS OF STREAM TERRACES

In the past the streams apparently flowed at higher levels than at present and deposited sand, silt, clay, and gravel on their flood plains just as streams at the present time are depositing such materials. When the channels of these ancient streams had deepened, new flood plains were formed at lower levels, but remnants of the old flood plains still remain in places that lie above overflow from the present streams. In this county these remnants of former flood plains constitute terrace lands, known to some as second bottoms or benches.

In most places the level to gently sloping terrace lands lie adjacent to the flood plains or bottom lands. The slope gradient is 7 percent or less. The Holston and Wolftever series include all the terrace lands in the county. The Holston soil has formed from alluvial material derived from uplands underlain by sandstone and shale and the Wolftever from alluvial materials derived from uplands underlain chiefly by limestone. The Holston is well drained, but the Wolftever is imperfectly drained.

HOLSTON SERIES

The soil of the Holston series has a gray, light grayish-brown, or grayish-yellow friable surface soil and yellow moderately firm but friable subsoil. Below the subsoil the material consists of splotched gray and rust-brown slightly compact fine sandy clay or sandy clay. The series is represented by Holston fine sandy loam, which has a total area of 775 acres. Practically all this soil has been cleared and is used chiefly for corn, small grains, hay, pasture, and truck crops.

WOLFTEVER SERIES

The soil of the Wolftever series is on low terraces and, in places, is subject to overflow by the streams during exceptionally high floods. This soil is very gently sloping to gently sloping, the slope gradient ranging from 2 to 7 percent. Imperfect drainage is caused by a compact layer occurring in the profile at a depth of 24 to 36 inches. Drainage, however, is not restricted enough to interfere materially with the production of crops.

The soil of this series has light-brown or grayish-brown mellow surface soil and yellow or yellowish-brown heavy-textured tough plastic subsoil, which is underlain by yellow tight compact silty clay, highly mottled with gray and brown. Wolftever silt loam (123 acres) is the only member of the series mapped. All the soil has been cleared and is used for crops, chiefly corn, small grains, and hay.

SOILS OF BOTTOM LANDS

The bottom lands include soils of the Huntington, Dunning, Pope, Philo, and Atkins series. These lands comprise the flood plains of the county and at times are overflowed by the adjacent streams. They are elevated only a few feet above the streams and are level or nearly level, the gradient being 2 percent and less. These soils owe their differences mainly to variations in the character of the parent material and in condition of drainage. They are young to very young in degree of development.

The alluvial materials that gave rise to the Huntington and Dunning soils came chiefly from uplands underlain by limestone. The Huntington soil is well drained and the Dunning imperfectly to poorly drained. The alluvial materials that gave rise to the Pope, Philo, and Atkins soils came chiefly from uplands underlain by sandstone and some shale. These soils constitute a catena, or chain, in which the Pope soil is well drained, the Philo imperfectly drained, and the Atkins poorly drained.

HUNTINGTON SERIES

The soil of the Huntington series is a well-drained productive soil of the first bottoms. The brown or dark-brown friable mellow surface

soil is underlain by brown or light-brown friable silt loam or silty clay loam to a depth of about 36 inches. The parent material consists of material washed chiefly from uplands underlain by limestone and deposited near streams by running water.

Huntington silt loam (239 acres) is the only type mapped. Nearly all of it occurs in first bottoms along the Sequatchie River. Practically all the soil is cleared and used mainly for corn, with hay and small grains grown to some extent.

DUNNING SERIES

The imperfectly to poorly drained soil of the Dunning series occurs in first bottoms near streams. The alluvial material from which this soil was derived originated in uplands underlain by limestone, although some of it may have come from uplands underlain by shale. This soil has a dark-gray to almost black firm but friable surface soil, which is underlain by a layer of mottled yellow, gray, and rust-brown compact tough plastic silty clay. Below this layer the material consists of bluish-gray compact tough silty clay.

Dunning silty clay loam, the only member of the series mapped, has a total area of 245 acres. Practically all this soil is cleared land, and its main use is for hay, pasture, and corn. When adequately drained, the soil is very productive of corn and hay. It has been artificially drained in some places.

POPE SERIES

The soil of the Pope series is a level or nearly level well-drained soil on stream bottoms. The alluvial material from which it was derived came chiefly from uplands underlain by sandstone and shale. The Pope soil has a grayish-brown or light-brown friable loose surface soil, underlain to a depth of 40 to 50 inches by light-brown or very light-brown friable fine sandy loam to loamy fine sand. Beneath this layer is a mottled yellow, gray, and brown friable soil material.

Pope fine sandy loam (2,430 acres) is the only member of the series mapped. About half of it is cleared land used mainly for corn, hay, and pasture. Small grains, truck crops, and other crops are of minor importance. In uncleared areas the trees consist mainly of oak, pine, black tupelo (blackgum), and yellow-poplar.

PHILO SERIES

The soil of the Philo series is intermediate in condition of drainage between the well-drained Pope soil on the one side and the poorly drained Atkins on the other. This level or nearly level soil occurs in first bottoms near streams and was derived from alluvial material that washed mainly from uplands underlain by sandstone and shale. The grayish-brown or grayish-yellow friable mellow surface soil is underlain by pale-yellow friable material to a depth of about 20 inches, where it gives way to mottled gray, yellow, and brown friable material.

Philo very fine sandy loam is the only member of the series mapped. Only a small part of the total area of 2,023 acres has been cleared. The cleared land is used mainly for hay, pasture, and corn, and a small acreage is planted to small grains.

ATKINS SERIES

Occurring in level or nearly level first bottoms, the soil of the Atkins series is associated with Pope and Philo soils in the Pope-Philo-Atkins catena and comprises the most poorly drained part of this catena. The Atkins soil has formed from alluvial material washed mainly from uplands underlain by sandstone and some shale. It has a gray, dark-gray, or gray mottled with yellow friable surface soil, underlain by a mottled gray, yellow, and rust-brown friable layer. At a depth of about 16 inches this mottled layer is underlain by material highly mottled with gray, blue, and yellow.

Atkins very fine sandy loam is the only representative of the series (3,865 acres) and is the most extensive soil of the bottom lands. A large part of the soil is in forest, consisting principally of black tupelo (blackgum) and red maple. The cleared land is used for hay and pasture and to a small extent for corn.

MISCELLANEOUS LAND TYPES

In addition to the 17 soil series mapped, 6 miscellaneous land types, which have a total area of 33,536 acres, were also mapped. These are Smooth stony land (Muskingum soil material), Rolling stony land (Muskingum soil material), Rough stony land (Muskingum soil material), Rolling stony land (Talbott soil material), Rough stony land (Talbott soil material), and Limestone outcrop. The first three are characterized by many loose sandstone fragments, outcrops of sandstone bedrock, or both. In general, the soil among the rocks is shallow to bedrock, and its profile characteristics are similar to those of Muskingum stony fine sandy loam. These three land types are differentiated mainly by differences in the character of their relief. Practically all of them are in forest because shallowness to bedrock and stoniness make them generally unsuitable for crops and pasture.

Rolling stony land (Talbott soil material) and Rough stony land (Talbott soil material) are characterized by outcrops of limestone bedrock, which occupy 10 to more than 50 percent of the surface of the land. The soil among these outcrops is similar to the stone-free Talbott soil of the county, although it may be shallower to bedrock in many places. The rock outcrops prevent tillage of the rolling stony land, but the land is generally suitable for pasture. Stoniness and the relief of the rough stony land types make them unsuitable for crops and pasture, and forest covers nearly all of them.

Limestone outcrop includes extremely stony land, consisting chiefly of outcrops of limestone bedrock and loose fragments of limestone rock. Small quantities of soil material occur among these rock outcrops and fragments. In addition to its stoniness, the land is generally hilly to steep; therefore it has very little value for crops, pasture, or forest.

DESCRIPTIONS OF SOIL UNITS

The soils of Cumberland County have been classified and mapped in 20 types,[7] 13 phases, and 6 miscellaneous land types. In addition

[7] When a soil type has been subdivided into phases, that part of the type that bears no phase name will be referred to as the normal phase of the type.

to the soils of this county the soils of a small part of White County (737 acres) within Cumberland County are shown on the map as follows: Muskingum stony fine sandy loam, 401 acres; its steep phase, 26; Muskingum fine sandy loam, 32; Hartsells fine sandy loam, 71; its rolling phase, 155; Philo very fine sandy loam, 39; and Rolling stony land (Muskingum soil material), 13.

In the following pages the soil types, phases, and land types are described in detail and their agricultural relations discussed. Their location and distribution are shown on the accompanying soil map, and their acreage and proportionate extent are given in table 12.

TABLE 12.—*Acreage and proportionate extent of the soils mapped in Cumberland County, Tenn.*

Soil type	Acres	Per-cent	Soil type	Acres	Per-cent
Atkins very fine sandy loam	3,865	0.9	Lickdale silt loam	504	0.1
Crossville loam	5,856	1.3	Limestone outcrop	691	.2
Rolling phase	8,441	1.9	Muskingum fine sandy loam	9,081	2.1
Shallow phase	1,344	.3	Muskingum stony fine sandy loam	151,914	35.1
Crossville stony loam	14,271	3.3	Steep phase	28,670	6.6
Dewey silt loam	136	(1)	Undulating phase	16,733	3.9
Rolling phase	84	(1)	Philo very fine sandy loam	2,023	.5
Dunning silty clay loam	245	.1	Pope fine sandy loam	2,430	.6
Emory silt loam	168	(1)	Rolling stony land:		
Hartsells fine sandy loam	71,437	16.5	Muskingum soil material	7,891	1.8
Deep phase	10,839	2.5	Talbott soil material	1,228	.3
Rolling phase	57,380	13.3	Rough stony land:		
Shallow phase	859	.2	Muskingum soil material	18,239	4.2
Hartsells silt loam	3,303	.8	Talbott soil material	5,061	1.2
Rolling phase	3,542	.8	Smooth stony land (Muskingum soil material)	426	.1
Hector stony fine sandy loam	937	.2	Talbott silt loam	523	.1
Steep phase	666	.2	Talbott silty clay loam:		
Holston fine sandy loam	775	.2	Eroded hilly phase	698	.2
Huntington silt loam	239	.1	Eroded steep phase	607	.1
Jefferson fine sandy loam	342	.1	Wolftever silt loam	123	(1)
Slope phase	355	.1			
Johnsburg very fine sandy loam	394	.1	Total	432,320	100.0

[1] Less than 0.1 percent.

Atkins very fine sandy loam.—This poorly drained soil in first bottoms near streams is associated with the Pope and Philo soils on level to nearly level relief (2 percent and less). It is derived from alluvial material washed chiefly from uplands underlain by sandstone and shale, and is elevated only a few feet above the adjacent streams and at times is overflowed. External and internal drainage are very slow.

This type is the most extensive soil of the bottom lands, covering a total area of 3,865 acres. It occurs in long narrow strips along many of the intermittent streams of the Cumberland Plateau; in many places these strips are only 10 to 50 feet wide. The largest areas are in Grassy Cove.

A profile of this type shows the following characteristics:

0 to 7 inches, gray to dark-gray friable very fine sandy loam, containing a moderate quantity of organic matter.

7 to 16 inches, mottled gray, yellow, and rust-brown friable very fine sandy clay.

16 to 35 inches, highly mottled gray, blue, and yellow friable very fine sandy clay.

35 inches +, bluish-gray friable very fine sandy clay.

The thickness and texture of the layers vary somewhat from place to place. In some places the texture is lighter than that of the above

profile and in others heavier; in a few places the subsoil layer is moderately compact.

This soil has fair conservability, but poor workability and productivity. It is generally strongly acid throughout and is moderately well supplied with organic matter; the content of lime and phosphate, however, is low. Poor drainage restricts the use of this soil, and adequate drainage for the production of cultivated crops is one of the important problems of management. In its present condition, it is very poor to poor cropland and fair pasture land.

Only about 10 percent of the total area has been cleared for agricultural use, probably 75 percent of this being used for hay and pasture and most of the rest for corn. In dry years when the moisture relation is better than normal, corn produces moderately well. Even so, it would be infeasible to grow cultivated crops unless the soil has been artificially drained, but if adequately drained it may produce fairly good yields of corn. Increased yields may be expected on the drained land when properly treated with lime and phosphate. On the uncleared land are nearly pure stands of black tupelo (blackgum) and red maple.

Crossville loam.—This soil has been formed from weathered material of a rock formation consisting of sandstone and some shale. External drainage ranges from very slow to medium, and internal drainage is medium. Although the soil is well drained, here and there are some small seepy places. The relief is level to undulating, the gradient being not more than 5 percent.

The soil occurs on the Cumberland Plateau in nearly all parts of the county in relatively small- to medium-sized areas. The total of 5,856 acres occupies positions on smoother parts of interstream divides in association with the Hartsells series.

Under virgin conditions a profile of this type has the following characteristics:

0 to 2 inches, dark grayish-brown or dark-brown friable loam. A fairly large quantity of organic matter is mixed with the mineral material of this layer.
2 to 7 inches, grayish-brown or brown mellow loam.
7 to 22 inches, yellowish-brown friable fine sandy clay.
22 to 30 inches, grayish-brown or brownish-gray friable fine sandy loam mixed with many angular sandstone fragments up to 6 inches in diameter.
30 inches +, sandstone bedrock in horizontal strata; in places some shale is interstratified with the sandstone.

Throughout the extent of this soil the layers of the profile vary considerably in thickness. In cultivated fields the color of the plowed layer is generally lighter than that of the surface soil in forested areas.

This soil has excellent workability, good conservability, and fair productivity. It is strongly acid and has a low content of mineral plant nutrients and a fair to low supply of organic matter. The soil is easily pervious to moisture, air, and roots, and its water-holding capacity is moderate. Moisture conditions are favorable for plant growth, and the control of erosion presents little or no problem. This soil is fair to good cropland and good pasture land.

About 25 percent of the total area is cleared land used for corn, hay, wheat, oats, and sorghum, and also for potatoes, sweetpotatoes, and other vegetables. Probably 40 percent of the cleared land is used for

corn, 40 percent for hay crops, and the rest for other crops. In a normal season and under the management commonly practiced, corn yields about 25 bushels an acre, wheat about 10, potatoes about 100, sweetpotatoes about 90, and hay about 1 ton. The trees on the forested land are mainly post oak, Southern red oak, scarlet oak, pine, and some hickory.

Experience of farmers and limited experimental data indicate that this soil can be rather productive with proper management, including the use of green manure (*8, 13*) and amendments, especially lime and phosphate (*7*). In general, this soil responds satisfactorily to about the same fertilizer treatment and other management practiced on Hartsells fine sandy loam.

Crossville loam, rolling phase.—The rolling phase differs from the normal phase of this type primarily in having a stronger relief (5 to 9 percent); it is a little shallower to bedrock, and there is slightly more seepage of water from the upper slopes. The stronger relief affects to some extent the management of the soil, especially in problems relating to the control of water on the land. External drainage is slow to medium, although in cleared land it may be rapid in places; internal drainage is medium.

The total area of 8,441 acres occurs on the Cumberland Plateau in nearly all parts of the county associated with other Crossville soils and with those of the Hartsells and Muskingum series. In many places it occurs in long narrow strips between the loam and the stony loam.

Because of its stronger relief and shallower depth to bedrock, this rolling phase is not so well suited to the production of crops as the normal phase. It is subject to considerable erosion, and as its profile is already relatively shallow to bedrock, the control of erosion is an important problem. Workability is good, and conservability and productivity are fair. Moisture, air, and roots penetrate the soil easily. The soil has a medium water-holding capacity and is fair cropland and pasture land.

About 5 percent of the total area of this soil has been cleared for cropland and pasture land. Probably 50 percent of the cleared land is used for hay, 30 percent for corn, 15 percent for pasture, and the rest for wheat, oats, potatoes, sweetpotatoes, and other vegetables. Under the management commonly practiced, hay yields about 1 ton an acre, corn about 18 bushels, wheat about 6, potatoes about 100, sweetpotatoes about 90. Other vegetables and oats give returns commensurate to those of other crops grown. Post oak, Southern red oak, scarlet oak, and pine are the main trees on the uncleared land.

Management required consists mainly of proper fertilization and the use of crop rotations to control the water on the land. Good response may be expected from the use of green manure, lime, and phosphate. Strict attention should be given to the control of erosion, for when erosion has reduced the depth of the profile over bedrock, the use of the soil for agriculture is greatly impaired. A 3- or 4-year rotation is best for the control of erosion and for other benefits to the soil. These rotations would include a row crop the first year, followed by grass or leguminous crops for either 2 or 3 years. Whichever rota-

tion is practiced, a winter cover crop of crimson clover or some other legume should follow the row crop.

Crossville loam, shallow phase.—This phase differs from the normal phase of this type in being shallower to bedrock, which may be reached at a depth of 12 to 18 inches. In some places the soil is even shallower, and in some others there are flat narrow exposures of the sandstone bedrock, 2 to 15 feet in length. There is also more seepage of water from the upper slopes than is characteristic of the type. External drainage is slow to medium; internal drainage is medium, but it is obstructed in places by bedrock. The relief ranges from level to rolling, the gradient of the slope being 9 percent and less.

Covering a total area of 1,344 acres, this soil occurs in rather small bodies widely scattered over the Cumberland Plateau northwest of the Crab Orchard Mountains. It generally is associated with other Crossville soils and with those of the Hartsells and Muskingum series.

This soil has very good workability, good conservability, and poor productivity. It is, however, susceptible to much damage by accelerated erosion, and precautions are necessary to prevent loss of soil material. Owing to its shallow depth to bedrock, the soil dries out more quickly than many of the soils of greater depth. This shallow phase is considered to be poor to fair cropland and fair pasture land.

About 3 percent of this phase is cleared land—of this, about 60 percent is used for hay and pasture, about 30 percent for corn, and most of the rest for small grains and vegetables. Low yields of crops and pasture are obtained when the seasons are unfavorable, and even in favorable seasons the reported yields for most crops are much less than those obtained on Crossville loam. Most of the soil is covered with a forest of post oak, Southern red oak, scarlet oak, pine, and some hickory. In areas where there is much seepage of water the forest consists principally of a thin stand of stunted post oak.

Because it is easily eroded when cropped, this shallow phase is better suited to pasture than to crops, especially row crops. Many years would be required in which to rebuild the soil from the eroded condition that could be caused by use of a row crop even 1 year. If the farm program calls for more pasture land, this shallow phase should produce fairly good pasture, providing suitable management is practiced. The pasture already on the land could probably be improved by applications of about 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre. This treatment should be repeated every 3 or 4 years, but smaller quantities of these amendments can be applied.

Crossville stony loam.—This type differs from Crossville loam mainly in being stony, in having a shallower and more uneven depth to bedrock and, in general, in having a stronger slope and more seepage of water from the upper slopes. The relief is level to rolling, the gradient of the slope being 9 percent and less. External drainage is slow to medium and internal drainage medium.

Covering an aggregate area of 14,271 acres, this soil is on the Cumberland Plateau in nearly all parts of the county and generally occurs in long strips associated with areas of other Crossville soils, with soils of the Hartsells series, and with Muskingum stony fine sandy loam.

In forested areas this soil has a grayish-brown or brown mellow loam

surface soil, 5 to 7 inches thick. The first inch or two is somewhat darker because of the presence of a moderate quantity of organic matter composed of decayed leaves, twigs, and other vegetable matter. The subsoil consists of yellowish-brown friable fine sandy clay, 8 to 18 inches thick. Beneath the subsoil is a layer of grayish-brown or brownish-gray friable fine sandy loam, 3 to 8 inches thick, underlain by the parent rock of sandstone and some shale in horizontal strata. A large number of angular sandstone fragments, up to 8 inches in diameter, are on the surface and mixed through the profile. These fragments are so numerous that the soil is stony. When the land is cleared and cultivated, the organic matter of the upper layer is soon mixed with the plowed layer, and the soil of this layer generally becomes slightly lighter in color.

This soil is strongly acid throughout and has a low content of mineral plant nutrients. The supply of organic matter is apparently rather low. The soil retains moisture less well than some of the other soils of the county and tends to dry out fairly readily. Unless properly managed, it is subject to some accelerated erosion. Owing to its stoniness it has only fair workability and conservability and poor productivity. It is considered poor cropland and fair pasture land.

Probably 3 percent of the total area of this soil is cleared land, of which about 60 percent is used for hay and pasture, about 30 percent for corn, and the rest for small grains and vegetables. Under the management commonly practiced, the yields of hay crops are about ½ ton an acre, corn about 13 bushels, wheat about 6, potatoes about 80, and sweetpotatoes about 60. The rest of the soil is covered by a mixed forest of post oak and Virginia pine.

If good management were practiced, this type would produce satisfactory pasture. Such management, among other practices, would require initial applications of 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre, and repeated applications of these amendments every few years.

Dewey silt loam.—This soil occurs on uplands underlain by limestone and is characterized by a brown mellow rather thick surface soil and by a red friable subsoil. It is formed from residual material of high-grade limestone or high-grade dolomitic limestone. The relief is gently undulating to undulating, the slope ranging from 2 to 7 percent. External drainage is slow to medium, and internal drainage is medium.

Most of the total area of 136 acres is in areas less than 10 acres in size. All the soil is in Sequatchie Valley, associated with the rolling phase and with the Talbott soils. It is productive and well suited physically to agricultural use.

In uneroded fields a profile of this type has the following characteristics:

0 to 10 inches, grayish-brown to light-brown mellow silt loam, containing a relatively large quantity of well-decomposed organic matter.

10 to 42 inches, red or pale-red firm but friable silty clay. This material breaks down to small rather soft subangular aggregates that may be crushed easily to a reddish-colored smooth mass.

42 inches +, reddish-yellow heavy-textured silty clay, splotched with yellow, red, and gray. Bedrock, consisting of high-grade limestone or dolomitic limestone, underlies the profile at a depth of about 20 feet.

The surface soil of the profile varies in thickness from 8 to 14 inches, the subsoil from 40 to 50 inches, and the substratum has a maximum of about 15 feet.

This type has very good workability and conservability and good productivity. The surface soil contains a rather large quantity of organic matter and possesses good tilth. The soil is acid throughout and is naturally high in fertility and productivity. It is easily pervious to air, moisture, and roots and has a fairly high water-holding capacity; it is good to very good cropland and very good pasture land.

All the soil has been cleared for agricultural use. About 50 percent of the total area is used for corn, 30 percent for hay, and the rest for small grains, pasture, tobacco, and vegetables. Under the management commonly practiced the yields of corn are about 35 bushels an acre, hay crops about 1½ tons, and wheat about 20 bushels. Relatively high yields of pasture, tobacco, and vegetables are expected. Some alfalfa is grown, and the yields range from 2 to 4 tons an acre.

With proper use and under reasonably good practices of management, this type should continue to be a good soil for agriculture. Such practices as systematic rotation of crops, proper tillage, and the correct use of lime and fertilizers can be expected to keep the soil in a condition of high productivity. The following fertilizers and quantities an acre are suitable for specified crops that may be grown on this soil: For corn and small grains, 250 pounds of 6–8–0; for small grains to be followed by clover and grass, 300 pounds of 4–10–5; for cowpeas, soybeans, and other legumes, 250 pounds of 0–10–5; for tomatoes, potatoes, and other vegetables, 500 pounds of 6–10–4; for meadow and pasture, 200 pounds of 8–8–5; and for tobacco, 600 pounds of 6–10–4. Applications of about 2 tons of ground limestone give good results particularly for legumes.

Dewey silt loam, rolling phase.—The main difference between this phase and the normal phase of the type is that the rolling phase has a stronger slope (7 to 15 percent), a little thinner surface soil, slightly inferior tilth, and a smaller content of organic matter. The use suitability of the two soils is practically the same, although the difference in slope affects to some extent the management of these soils. This phase has medium to rapid external drainage and medium internal drainage. Many small eroded patches, having a reddish-brown heavy-textured surface soil, occur in the soil as mapped. The total area of 84 acres is in Sequatchie Valley associated with the normal phase and with soils of the Talbott series.

This soil has good workability, conservability, and productivity, is fairly well supplied with organic matter, and is acid throughout. It is permeable to air, moisture, and roots and holds moisture well. A good condition of productivity can be maintained fairly easily by suitable practices of management. It is good cropland and pasture land.

Practically all this rolling phase has been cleared and is in agricultural use. Probably 40 percent of the cleared area is used for corn, 30 percent for hay crops, and the rest for other crops. Under the management commonly practiced, crop yields are generally a little less than those obtained on the normal phase.

This rolling phase responds well to about the same fertilizer treatment as suggested for the normal phase of the type. The control of water is a major problem in the management of the soil. In general, for this purpose less time should be given to row crops in the rotations practiced and more to close-growing and sod-forming crops. Tillage should also be on the contour, and proper kinds and quantities of lime and fertilizer should be applied. In some places terracing and strip cropping might be advisable.

Dunning silty clay loam.—This dark-colored poorly drained soil of the stream bottoms is derived from alluvial materials of the uplands underlain by limestone and in places by shale. It is characterized by a mottled tough plastic subsoil. The relief is level or nearly level, the gradient of the slope being 2 percent or less. External and internal drainage are very slow. The total area of 245 acres is mostly in Grassy Cove. Drainage from this cove empties into an underground passage, but during heavy rains the outlet clogs and causes a large area to be flooded for several days. The alluvial materials left in floods have given rise to this soil in the cove.

Following are the profile characteristics of this type:

0 to 10 inches, dark-gray firm but friable silty clay loam, which is granular when dry. The material contains a moderate quantity of decayed vegetable matter and is nearly black when wet.

10 to 15 inches, gray firm somewhat plastic silty clay loam containing a small quantity of organic matter.

15 to 30 inches, yellow mottled with gray and rust-brown silty clay. The material is tough, compact, and plastic but breaks down to small firm angular aggregates when dry.

30 inches +, bluish-gray tough compact plastic silty clay that breaks down to larger aggregates than those of the overlying layer.

Throughout this soil the thickness of the profile layers varies somewhat from the thickness of the layers of the above profile.

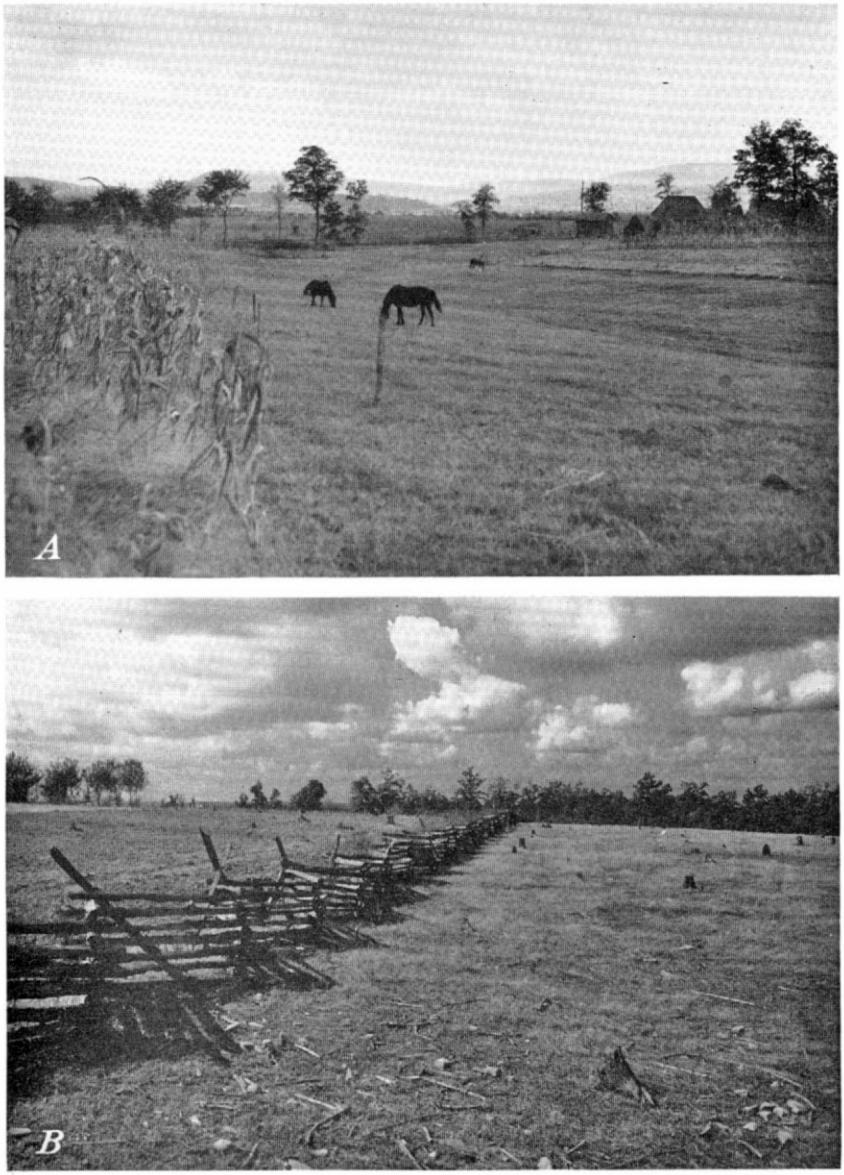
The workability of this soil is very poor, but the conservability is very good and productivity is fair. The soil is generally neutral in reaction. Poor drainage restricts its use for crops, but where adequately drained artificially, the soil is very productive of corn and hay. The undrained soil is best suited to hay crops and pasture. This type is naturally high in content of plant nutrients. Its main management requirement is adequate underdrainage.

Nearly all this soil has been cleared for agricultural use. About 60 percent of the cleared land has been artificially drained to some extent. Probably 70 percent of the cleared land is used for hay and pasture and nearly all the rest for corn. Excellent yields of hay and pasture are obtained on the artificially drained land. Corn yields, however, are uncertain and range from low to high, depending chiefly on the seasons.

Emory silt loam.—This reddish-brown well-drained soil occurs on foot slopes of uplands underlain by limestone. It is formed from material that washed and sloughed mainly from Dewey and Talbott soils and is highly productive of pasture and of most crops grown in the county. This level to gently sloping type (7 percent and less) has very slow to medium external drainage and medium internal

A, Road cut exposing a typical profile of Hartsells fine sandy loam. Sandstone bedrock, the light-colored layer just below the spade, is at a depth of 32 to 36 inches.

B, Cut in Muskingum stony fine sandy loam showing a few inches of soil over the rock in the foreground and the stoniness of the somewhat more deeply weathered area in the background.



A, Pasture on Hartsells fine sandy loam that affords very little grazing during dry periods, because of low moisture-holding capacity; the best grazing is in swales, where moisture for grasses is more favorable.

B, Newly cleared tract of land on Hartsells and Crossville soils with many stumps still intact, both in the pasture to the right and the cultivated field to the left. Wooden rails for fences are one of the uses made of timber cut from the land.

drainage. Practically all the land is cleared and covers a total area of 168 acres in Sequatchie Valley and Grassy Cove.

A profile of this type has the following characteristics:

0 to 14 inches, dark reddish-brown mellow silt loam containing a moderate quantity of organic matter.
14 to 40 inches, reddish-brown to yellowish-red firm friable clay loam or silty clay loam containing a few small chert fragments.
40 inches +, reddish-brown to yellowish-brown friable fine-textured soil material that varies somewhat in physical characteristics from place to place.

The thickness of the first layer ranges from 12 to 18 inches and that of the second layer from 36 to 48.

This type has very good workability, conservability, and productivity and is fairly well supplied with organic matter. The content of essential plant nutrients is fairly high. Air and moisture permeate the soil easily, plant roots penetrate it freely, and water-holding capacity is good. It is good to very good cropland and very good pasture land.

All the cleared soil is used as cropland. About 70 percent of the cleared land is used for corn, 20 percent for hay crops, and the rest for wheat and other crops. Under the management commonly practiced, corn produces about 45 bushels an acre, wheat about 20, and hay crops yield 1½ to 2 tons. Other crops return correspondingly good yields. Management requirements include such practices as systematic rotation of crops, proper tillage, and correct use of fertilizers. The fertilizer treatment for the crops grown on Dewey silt loam is suitable for similar crops grown on this type.

Included with this type are areas of Abernathy silt loam and Etowah silt loam too small to show on the map. The Abernathy soil has a reddish-brown friable silt loam surface soil and a brown to reddish-brown friable subsoil. It has formed from colluvial material washed from uplands underlain by limestone and occurs in flat places and slight depressions. The Etowah soil occurs on stream terraces and is characterized by a brown mellow surface soil and a brownish-red friable subsoil. These included soils have about the same use, management requirements, and productivity as Emory silt loam.

Hartsells fine sandy loam.—This light grayish-yellow very friable soil having a yellow friable subsoil extends over a total of 71,437 acres in all parts of the county but is most extensive on the northwest side of the Crab Orchard Mountains. It is the most extensive soil type suited physically to the production of crops. Only a small total area, however, is cleared land. In most places it occupies positions on the smoother parts of interstream divides. The soil occurs in long strips that vary considerably in width but in many places are so narrow that it is difficult to lay out fields of 10 to 20 acres without other soils of different use suitability being included. It is associated with other Hartsells soils and with those of the Crossville and Muskingum series. The relief is level to gently undulating (5 percent and less). External drainage is very slow to medium and internal drainage medium.

Under virgin conditions this type has the following profile (pl. 3, *A*) characteristics:

0 to 2 inches, gray mellow fine sandy loam mixed with a small quantity of decayed vegetable matter.
2 to 9 inches, grayish-yellow or yellowish-gray friable fine sandy loam.
9 to 30 inches, yellow or brownish-yellow friable fine sandy clay containing a few red and brown mottles, apparently caused by decomposed fragments of sandstone rather than by imperfect drainage.
30 to 34 inches, yellowish-gray fine sand mixed with many small partly weathered sandstone fragments.
34 inches +, sandstone bedrock containing thin layers of shale in places; the strata of the bedrock are horizontal.

Variations exist in the thickness of the different layers of the profile. In the first layer the thickness ranges from 1 to 2 inches, in the second from 6 to 8, in the third from 15 to 24, and in the fourth from 2 to 12. In cleared land the plowed layer consists of light grayish-yellow to yellowish-gray very friable fine sandy loam.

This fine sandy loam has excellent workability, good conservability, and fair productivity. It is strongly acid and has a low content of organic matter and mineral plant nutrients. It, however, lies favorably for cultivation, has excellent tilth, and is readily responsive to fertilization and other practices of management. Cultivation can be extended over a wide range of moisture conditions. The soil is easily pervious to moisture, air, and roots and has a fairly good moisture-holding capacity. This fine sandy loam is fair to good cropland and good pasture land (pl. 4, *A*).

Probably 20 percent of this soil has been cleared (pl. 4, *B*). Corn, hay, wheat, and sorghum, and potatoes, sweetpotatoes, and other vegetables are the principal crops grown. About 40 percent of the cleared land is used for corn, 40 percent for hay, 5 percent for potatoes, and the rest for other crops. Under the management commonly practiced, corn yields about 20 bushels an acre, hay crops about 1 ton, wheat about 10 bushels, sorghum about 60 gallons of sirup, potatoes about 120 bushels, and sweetpotatoes about 105 bushels. This soil is especially well suited to potatoes, sweetpotatoes, and other root crops adapted to this climate and is well suited to a number of other vegetables that could be grown for the market (pl. 5, *A*). The forest on a large part of this type consists mainly of post, Southern red, scarlet, and blackjack oaks, hickory, and pine (pl. 1, *B*).

Owing to its gentle slope and ready absorption of rain water, this soil is not very susceptible to accelerated erosion; but because of the shallowness of the soil to solid rock, any extent of such erosion harms the soil and should be avoided. Apparently erosion can be held in check by proper use and management.

Experience of farmers and also results of experiments indicate that this soil can be made rather productive by proper practices of management. Among these practices are the turning under of green manure (*8*, *13*) and other manure (*9*) and the use of amendments, especially lime and phosphate (*7*). Experiments conducted for 10 years by the Tennessee Agricultural Experiment Station on this soil near Crossville show the effects of liming and of different forms of phosphates when used alone and in connection with liming on crop yields. Other experimental work over the same period indicates that the most profitable quantities of 16-percent acid phosphate, or its equivalent,

applied per acre for different crops are as follows: For corn, 200 pounds; for potatoes, 400 pounds; for oats, 300 pounds; and for clover and grass hay, 400 pounds (*11*).

Some areas of Hartsells fine sandy loam, deep phase, too small to be separated on the map, are included with this soil. The profile is somewhat deeper to bedrock than that of the normal phase. Some of the smoother areas have incipient siltpans at a depth of 20 to 24 inches.

Hartsells fine sandy loam, rolling phase.—The relief of this phase ranges from undulating to rolling (5 to 9 percent slope), but it is predominantly rolling. External drainage is medium to rather rapid and internal drainage medium. With an aggregate area of 57,380 acres, it is found in all parts of the county, but most of it lies in long narrow bodies northwest of the Crab Orchard Mountains associated with other Hartsells soils and with those of the Muskingum series.

Owing to its stronger relief and more variable depth to bedrock, the rolling phase is not so well suited to the production of crops as the normal phase of the type. It has good workability and fair conservability and productivity. It is susceptible to accelerated erosion; and if the erosion is allowed to continue, the depth of the soil to bedrock will decrease and thereby greatly impair the soil agriculturally. The control of accelerated erosion is, therefore, of primary importance in the use of this soil for agriculture. This is a poor to fair cropland and fair pasture land.

About 5 percent of the total area of this rolling phase has been cleared and is used mainly for hay, corn, and pasture. About 50 percent of the cleared land is used for hay crops, about 30 percent for corn, about 15 percent for pasture, and the rest for wheat, oats, and vegetables, including potatoes. For most of the crops grown the yields are somewhat lower than for similar crops grown on the normal phase under similar practices of management. Under the common practices of management, yields for hay are about 1 ton an acre, corn about 15 bushels, wheat about 6, and potatoes about 100. On the uncleared land the trees are mainly post, Southern red, scarlet, and blackjack oaks, pine, and hickory.

The main management requirements are proper liming, fertilization, and rotation of crops. This soil should respond well to the fertilization suggested for the normal phase. Preferred rotations of crops are 3-year and 4-year, which include a row crop the first year, followed either for 2 or 3 years by grass or legumes. As the cultivated soil is rather susceptible to erosion, a cover crop, preferably crimson clover or some other legume, should be kept on the land in winter to help reduce washing.

Hartsells fine sandy loam, deep phase.—The deep phase differs from the normal phase of the type chiefly in its greater depth to bedrock, which generally ranges from 40 to 60 inches. As a result of this greater depth, the layers of the profile are thicker. In many places the color of the profile for 10 to 15 inches above the bedrock is yellowish red rather than yellow. This phase is level to undulating, the gradient of the slope being 5 percent and less. The soil has very slow to medium external drainage and medium internal drainage.

The aggregate area of 10,839 acres is northwest of the Crab Orchard Mountains, the larger tracts occurring in the vicinity of Crossville, Bethlehem Church, Plateau, Mayland, and in the north-central part of the county. The soil is associated with other Hartsells soils and with those of the Crossville and Muskingum series.

This deep phase has excellent workability, good conservability, and fair productivity. It is strongly acid and low in content of organic matter and mineral plant nutrients but is readily responsive to fertilization and other practices of management. It is easily pervious to moisture, air, and roots, and retains moisture fairly well. Cultivation is possible over a wide range of moisture conditions. This phase is fair to good cropland and good pasture land.

About 25 percent of this soil has been cleared. Of this about 40 percent is used for corn, 40 percent for hay crops, 7 percent for potatoes, and the rest for other crops and vegetables. Under the common practices of management, the yields of most of the crops are somewhat higher than those obtained on the normal phase. Probably 75 percent of the total area of the soil is forested, the trees consisting of the same species as grown on the normal phase.

Management requirements are practically the same as those for the normal phase. As it is generally deeper to bedrock, more resistant to drought, less susceptible to accelerated erosion, and has more favorable moisture relations for plant growth, it is a more desirable soil for agricultural use. Because of its rather deep profile over bedrock and its seemingly favorable moisture relation, this deep phase would be suitable physically for the production of alfalfa if proper practices of management were employed.

Included with this deep phase as mapped are areas of other Hartsells soils that were too small to indicate on the map.

Hartsells fine sandy loam, shallow phase.—This shallow phase differs from the normal phase of the type in being shallower to bedrock, which underlies the soil at a depth of 18 inches or somewhat less. In some places small flat exposures of bedrock consist mainly of sandstone. As a result of the shallow profile, the soil layers are relatively thin. The phase is level to rolling, the gradient of the slope being 9 percent and less. External drainage is slow to rather rapid and internal drainage medium.

A total area of 859 acres occurs in rather small areas, widely scattered over the Cumberland Plateau northwest of the Crab Orchard Mountains. It is generally associated with other Hartsells soils and with those of the Muskingum series. Only a very small part of the total area has been cleared for agricultural use. The trees on the uncleared land are mainly oak, pine, and hickory.

This phase has very good workability, good conservability, and poor productivity. It is strongly acid and low in content of organic matter and essential plant nutrients. Because of the shallowness of its profile to bedrock, the soil dries out readily in most places. It is poor cropland and fair pasture land.

Only about 2 percent of this phase has been cleared for agricultural use. The main use for the cleared land is hay crops, corn, and pasture, but a small part is used for wheat, rye, potatoes, and other crops. Under the common practices of management and in favorable

A, Good tilth for seeding and growing truck crops on Hartsells fine sandy loam; because of the favorable qualities of the soil, potatoes, snap beans, cabbage, tomatoes, and beets and other root crops do well.

B, Muskingum stony fine sandy loam, undulating phase, on a slope of 9 percent and less. Stoniness and shallowness to bedrock make this soil unsuitable in most places for tilled crops. Properly seeded and fertilized, however, it will produce fair pasture in many places during favorable seasons.

seasons, yields of hay crops are about ½ ton an acre, corn about 10 bushels, wheat and rye about 6, and potatoes about 90. Pasture yields are fairly low.

One of the most important problems in the use and management of this shallow phase is the control of water. As the soil profile is relatively shallow to bedrock, the loss of a few inches of soil material through accelerated erosion would practically eliminate the use of the soil for cultivated crops. Its best use therefore is for close-growing crops.

Although this soil has low natural fertility and productivity, pasture would be a feasible use. The quantity and quality of the pasture would be greatly improved by the use of 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre. Good management would require that this treatment be repeated every few years.

Hartsells silt loam.—The total area of 3,303 acres of this soil is associated with other Hartsells soils on the Cumberland Plateau—the principal areas being in the vicinity of Genesis and Westel. The soil is developed from residual material of weathered shale and sandstone of very fine texture and differs from the fine sandy loam mainly in having a finer texture and a slightly compact subsoil. The relief ranges from level to undulating (5 percent and less). External drainage is very slow to medium, and internal drainage is medium, though in some places it is rather slow. The soil is largely forested with post, Southern red, scarlet, and blackjack oaks, and hickory and pine.

Under virgin conditions a profile of this type has the following characteristics:

0 to 1 inch, gray friable silt loam containing a small quantity of organic matter derived from decayed leaves, twigs, and other vegetable matter.
1 to 8 inches, grayish-yellow mellow silt loam containing very little organic matter.
8 to 30 inches, pale-yellow friable very fine sandy clay.
30 to 38 inches, grayish-yellow compact weakly cemented very fine sandy loam.
38 inches +, bedrock of interstratified shale and sandstone.

The thickness of the layers varies somewhat from place to place. In some of the smoother areas internal drainage is slightly restricted by an imperfectly developed siltpan at a depth of about 24 inches. This layer consists of a light-gray moderately compact heavy silt loam or silty clay loam splotched with brown and yellow. In cultivated areas the plowed layer is pale yellowish gray.

The workability of the soil is very good, the conservability good, and the productivity fair. This strongly acid soil has a low content of organic matter. Although its natural productivity is probably slightly higher than that of Hartsells fine sandy loam, the soil responds well to fertilization. Moisture, air, and roots penetrate the soil easily, and its moisture-holding capacity is fair. It is fair cropland and good pasture land. Management requirements are about the same as for the fine sandy loam. They include mainly proper liming, fertilization, and proper choice and rotation of crops.

About 20 percent of the total area of this soil has been cleared. In general, the soil is physically suited to the same kinds of crops as are

grown on Hartsells fine sandy loam and is a little more productive except for potatoes and other vegetables, for which it seems to be less productive. About 45 percent of the cleared soil is used for hay crops, about 45 percent for corn, and the rest for other crops. Under the management commonly practiced, corn yields about 25 bushels an acre, hay crops about 1 ton, wheat about 13 bushels, and potatoes about 80.

Hartsells silt loam, rolling phase.—The principal difference between this phase and the normal phase of the type is that the relief is stronger, the slope ranging from 5 to 9 percent in gradient. External drainage is medium to rapid and internal drainage medium. The profile is generally shallower to bedrock than that of the normal phase; therefore, the profile layers are not so thick in most places. Otherwise, the physical characteristics of the profiles are practically the same.

In most places the total area of 3,542 acres is associated with other Hartsells soils and with those of the Muskingum series. Only a very small part of the total area has been cleared for agricultural use. Trees on the forested land are post, Southern red, scarlet, and blackjack oaks and some pine and hickory.

In forested areas the surface soil consists of grayish-yellow friable mellow silt loam about 7 inches thick. The uppermost inch of the soil is stained dark by organic matter. The subsoil is pale-yellow friable very fine sandy clay to a depth of about 28 inches, where it gives way to very friable light grayish-yellow very fine sandy clay. In cultivated fields the plowed layer consists of yellowish-gray friable silt loam.

This phase has good workability and fair conservability and productivity. Its stronger relief and shallower depth to bedrock make it less well suited to the production of crops than the normal phase. This strongly acid soil is rather poorly supplied with organic matter and probably has a low supply of mineral plant nutrients. It is easily pervious to moisture, air, and roots, but has a rather low water-holding capacity and is poor to fair cropland and fair pasture land.

The principal management required by this phase consists of correct liming, fertilization, and proper choice and rotation of crops. The control of water is one of the more important problems of management. The use of suitable crop rotations and winter cover crops should prove effective in holding erosion in check.

About 5 percent of the total area of this phase has been cleared. About 60 percent of the cleared land is used for hay crops and pasture, about 30 percent for corn, and the rest for other crops. Lespedeza is the principal hay crop. Under the common practices of management, hay crops produce about 1 ton an acre and corn about 18 bushels. Wheat is grown to a small extent and produces about 9 bushels an acre.

Hector stony fine sandy loam.—Although rolling in some places, this soil is hilly. It occurs on steeper parts of the Cumberland Plateau and has a slope that ranges in gradient from 9 to 30 percent. Most of the 937 acres mapped is on slopes lying above the coves at Crab Orchard associated mostly with soils of the Muskingum series or with Rolling and Rough stony land (Talbott soil material). External drainage is medium to rapid and internal drainage medium to rather

rapid. Only a small part of the total area has been cleared for agricultural use. The trees on the uncleared land consist mainly of post, Southern red, and scarlet oaks, and pine and hickory.

This type is derived from weathered products of sandstone. Sandstone fragments, up to 10 inches in diameter, are strewn over the surface and embedded in the profile. These fragments are so numerous that the soil is stony. In a few places the soil has been formed from colluvial materials overlying limestone, and the limestone has influenced to some extent its development.

Under virgin conditions this type has the following profile characteristics:

0 to 2 inches, dark-gray very friable fine sandy loam containing a moderate quantity of decayed vegetable matter.
2 to 9 inches, grayish-yellow very friable fine sandy loam.
9 to 18 inches, yellowish-red friable fine sandy clay.
18 to 27 inches, red friable fine sandy clay.
27 to 36 inches, reddish-yellow friable fine sandy loam mixed with many small fragments of sandstone.
36 inches +, sandstone bedrock.

The different layers of the profile vary somewhat in thickness from that of the layers of the above profile.

The workability and productivity of this soil are very poor and its conservability poor. This strongly acid soil contains only a small quantity of organic matter and is low in content of essential plant nutrients. Moisture, air, and roots penetrate the soil easily. The water-holding capacity, however, is fairly low. In general the soil is very poor cropland and very poor to poor pasture land.

About 5 percent of the total area has been cleared and is used for crops and pasture. This soil, however, is poorly suited physically to crops but is somewhat more productive of crops than soils of the Muskingum series. It is probably a little better suited to pasture than Muskingum fine sandy loam. Under present conditions, however, the best use for it is forest.

Where the farm program requires the use of this soil, the less stony land would probably produce good pasture if properly fertilized and otherwise properly managed. Proper fertilization would require initial applications of about 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre and repeated applications of the phosphate every 3 or 4 years and of lime every 6 years.

Hector stony fine sandy loam, steep phase.—This steep phase is similar to the normal phase of this type in profile characteristics and differs from it mainly in having a stronger slope (30 percent and more). In most places the profile is slightly shallower to bedrock, and the soil is slightly more stony than that of the type. External drainage is rapid to very rapid and internal drainage medium to rapid. Practically all of this phase is in forest—post, Southern red, and scarlet oaks, pine, and hickory. In most places it is associated with other Hector soils and with soils of the Muskingum series. Most of the 666 acres mapped is on slopes that lie above the coves at Crab Orchard and Grassy Cove.

This phase has very poor workability, conservability, and productivity. It has a low supply of organic matter and is probably low in

content of mineral plant nutrients. It is a very poor cropland and very poor to poor pasture land.

Only a very small part of the soil has been cleared for agricultural use and the greater part of this has been abandoned as cropland and pasture land and is now grown over with trees. Because the soil is stony, steep, relatively shallow to bedrock, and probably low in content of essential plant nutrients, the most feasible use for it is forest.

Holston fine sandy loam.—A friable light-textured soil on terraces near streams that has a gray to brownish-yellow surface soil and a yellow subsoil, this soil has developed from sand, silt, and clay washed from uplands underlain chiefly by sandstone and shale and deposited near streams by running water. It is level to gently sloping, the gradient of the slope being 7 percent and less. External drainage is very slow to medium and internal drainage medium.

Practically all the 775 acres mapped has been cleared for agricultural use. This soil occurs mostly in Grassy Cove and Crab Orchard Gap and in the vicinity of Creston. It is associated generally with soils of the Pope and Philo series, which occur in the adjacent bottom lands.

Under virgin conditions this type has the following profile characteristics:

0 to 3 inches, gray friable fine sandy loam containing a small quantity of decayed vegetable matter.
3 to 10 inches, brownish-yellow friable fine sandy loam.
10 to 25 inches, yellow moderately firm but friable fine sandy clay.
25 to 55 inches, splotched gray and rust-brown slightly compact fine sandy clay or sandy clay. The splotches are more intense and the material more compact in the lower part of this layer.

The layers of the above profile vary somewhat in thickness from place to place. In the cleared soil the plowed layer is grayish brown to grayish yellow in color.

This fine sandy loam has excellent workability, good conservability, and fair productivity. The soil is acid, low in content of lime and phosphate, and has a rather low supply of organic matter that is soon depleted when the land is used continuously for such crops as corn or small grains. The soil is easily permeable to moisture, air, and roots and has a moderate to low water-holding capacity. It can be cultivated over a fairly wide range of moisture conditions and responds well to fertilization and other practices of management. It is a fair to good cropland and good pasture land.

About 60 percent of the total area of the cleared land is used for corn, small grains, and truck crops and the rest for hay and pasture. Crop yields vary somewhat, depending largely on practices of management. Under the management commonly practiced, corn yields about 25 bushels an acre, wheat about 13, hay crops 1 to 1½ tons, sorghum about 80 gallons of sirup, potatoes about 150 bushels, and sweetpotatoes about 120.

Proper fertilization is a very important practice required in the management of this type. If the needed amendments are applied, the productivity of this soil could be increased considerably and a greater variety of crops grown successfully. Among the more important fertilizing practices for this soil are the use of barnyard manure, lime, and phosphate; the use of green manure should be beneficial.

Huntington silt loam.—The soil is formed from sand, silt, and clay washed from uplands underlain mainly by limestone and deposited near streams by running water. It lies only a few feet above the adjacent streams and is overflowed now and then, and a small quantity of alluvial material is generally deposited on the soil each overflow.

The relief is level or nearly level. External drainage is very slow to slow and internal drainage medium. Practically all the 239 acres has been cleared for agricultural use. Most of this soil occurs in long, narrow bodies along the Sequatchie River associated chiefly with soils of the Dewey, Talbott, and Emory series and with the two land types of Rolling and Rough stony land (Talbott soil material), which occur on adjoining uplands. A few areas are in Grassy Cove and in some of the small coves.

The type has the following profile characteristics:

0 to 10 inches, dark-brown friable mellow silt loam. A moderate quantity of well-decomposed organic matter is incorporated with the mineral soil.
10 to 36 inches, brown or light-brown friable silt loam or silty clay loam.
36 to 48 inches, mottled gray, yellow, and brown friable silt loam or silty clay loam.

The thickness of the different layers varies from place to place, that of the first layer ranging from 8 to 12 inches, that of the second from 10 to 30, and that of the third from 11 to 30. In many places there is very little difference in color, texture, and consistence of the profile to a depth of about 36 inches; in a few places small fragments of chert or limestone occur in the profile at a depth of about 24 inches; and in a very few others these fragments are on the surface of the land.

The conservability and productivity of the soil are excellent and the workability very good. Tilth is excellent. The soil is generally about neutral in reaction, indicating a relative abundance of lime (available calcium). The content of organic matter is fairly high, and the soil is well supplied with mineral plant nutrients. It is easily pervious to moisture, air, and roots and has a good water-holding capacity. Crops grown in winter are likely to be winterkilled, or seriously damaged or destroyed by floods. Consequently, crops adapted to this soil are fewer than for many of the soils of the county. This type is good to very good cropland and very good to excellent pasture land.

About 70 percent of the total area of the cleared soil is used for corn and the rest for hay and small grains. The soil is generally highly productive of corn and hay. In many places corn is grown year after year with good results without the use of fertilizer, which is possible because the soil is naturally well supplied with essential plant nutrients.

Under management commonly practiced, corn yields about 50 bushels an acre, hay crops about 1¾ tons, and wheat about 10 bushels. As the workability, conservability, and productivity of the soil are naturally favorable to the production of crops, the management requirements are relatively few.

Jefferson fine sandy loam.—This well-drained soil is characterized by a grayish-yellow light-textured friable surface soil and a yellow friable subsoil. The relief is very gently sloping to gently sloping (2 to 7 percent). External drainage is slow to medium, and internal drainage is medium. The soil occupies positions at the foot of moun-

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tain slopes and has been formed from colluvial and alluvial materials washed almost entirely from soils of the Muskingum and Hector series.

A total of 342 acres is mapped in the county, and nearly all of it has been cleared for agricultural use. The soil is associated with soils of the Muskingum and Hector series and the rolling, rough, and smooth land types of the stony land (Muskingum soil material) of the uplands and with those of the terraces and bottom lands. It occurs in Crab Orchard Gap and Grassy Cove.

Under virgin conditions, this type has the following profile characteristics:

0 to 2 inches, gray very friable fine sandy loam containing a small quantity of decayed vegetable matter.
2 to 14 inches, grayish-yellow very friable fine sandy loam that contains very little organic matter.
14 to 36 inches, light-yellow friable fine sandy clay or sandy clay.
36 inches +, mottled yellow, gray, red, and brown friable fine sandy loam or sandy loam.

The depth of the profile to bedrock ranges from 4 to 20 feet. The thickness of the profile layers varies somewhat from place to place. In cultivated fields the color of the surface soil is generally grayish yellow.

This fine sandy loam has very good workability and good conservability and productivity. Tilth is good. The soil is strongly acid and low in content of organic matter and mineral plant nutrients, but it is readily responsive to fertilization. This type is easily permeable to moisture, air, and roots, and because it retains moisture fairly well, it can be cultivated over a wide range of moisture conditions. It is fair to good cropland and good pasture land.

About 90 percent of the total area of this soil is cleared land used chiefly for corn and hay. About 40 percent of the cleared land is used for corn, about 40 percent for hay crops, about 5 percent for potatoes, and the rest for other crops. Under the management commonly practiced, corn yields about 25 bushels an acre, hay about 1 ton, and potatoes about 150 bushels. Chief among the management practices considered to be required by this soil are the turning under of green manure and barnyard manure and the use of proper quantities of lime and phosphate.

This soil is similar in many respects to Hartsells fine sandy loam, although its profile is generally considerably deeper to the underlying solid rock. This soil, however, would be expected to respond to the same fertilization and other management practices as Hartsells fine sandy loam. It is adapted to about the same kinds of crops as the Hartsells soil, but it is better adapted to alfalfa and tobacco than that soil.

Included with Jefferson fine sandy loam as mapped are small areas in which the texture of the profile is somewhat heavier. Also included is a total of about 80 acres of Allen fine sandy loam, which differs from Jefferson fine sandy loam mainly in having a slightly brownish-red or yellowish-red subsoil rather than a yellow one.

Jefferson fine sandy loam, slope phase.—This phase differs from the normal phase of this type mainly in having a somewhat stronger slope. The slope gradient ranges from 7 to 15 percent, whereas that of the normal phase ranges from 2 to 7 percent. The difference in slope

affects to some extent the use and management of the two soils. This phase has medium external and internal drainage. In places on the stronger slopes, however, external drainage is rather rapid, and the control of runoff is one of the problems of management.

A large part of this soil, which covers a total area of 355 acres, has been cleared for agricultural use. It occurs in Crab Orchard Gap and Grassy Cove and is associated with soils of the Muskingum and Hector series and with Rolling, Rough, and Smooth stony lands (Muskingum soil material) of the uplands and with soils of the terraces and bottom lands.

The workability of this phase is good, and the conservability and productivity are fair. Owing to its stronger slope, this soil is not so well suited to crops as the normal phase, and the control of runoff is a more serious problem. This phase is acid throughout, low in content of organic matter, and probably low in supply of mineral plant nutrients. Moisture, air, and roots penetrate the soil easily. The water-holding capacity is moderately low. It is a soil that is poor to fair cropland and fair pasture land.

About 75 percent of the total area has been cleared, and the cleared land is used mostly for crops. About 50 percent of it is used for hay, about 30 percent for corn, and the rest for wheat and other crops. Under the management commonly practiced, hay crops yield about 1 ton an acre, corn about 20 bushels, and wheat about 7 or 8 bushels.

Application of fertilizer and control of water on the land are probably the main requirements in the management of this phase. Good responses to fertilizer may be expected. Phosphate seems to be especially needed; green manure and barnyard manure should be very beneficial; and lime also should benefit the soil. In the control of runoff, it is important that a cover crop, preferably crimson clover or some other legume, should be kept on the land in winter.

Included with the phase as mapped are small areas of Jefferson soil that have an unusually heavy texture throughout the profile. Also included are small areas of Allen fine sandy loam, slope phase, which have a red or brownish-red subsoil in contrast to a yellow subsoil of Jefferson fine sandy loam, slope phase. The areas of these included soils are too small to separate on the map of the scale used.

Johnsburg very fine sandy loam.—This soil is in flat places and slight depressions on the Cumberland Plateau. The relief is level to nearly level, the gradient of the slope being 2 percent and less. The use of the soil is somewhat restricted by imperfect drainage—external drainage is very slow to slow and internal drainage slow. A large part of the soil has never been cleared for agricultural use; on the uncleared land the trees are predominantly post oak, black tupelo (blackgum), and red maple.

This type is derived from weathered products of a rock formation, consisting of sandstone and small quantities of shale. The total area of 394 acres occurs mostly in widely scattered areas over the Cumberland Plateau northwest of the Crab Orchard Mountains, the principal areas lying northeast and southeast of Crossville. This soil is associated chiefly with those of the Crossville, Hartsells, and Lickdale series.

Under virgin conditions a profile of this type has the following characteristics:

0 to 4 inches, dark-gray mellow very fine sandy loam containing a moderate quantity of decayed vegetation.
4 to 10 inches, grayish-yellow smooth very fine sandy loam containing very little organic matter.
10 to 30 inches, pale-yellow friable very fine sandy clay.
30 to 35 inches, mottled gray, yellow, and brown slightly compact very fine sandy clay.
35 inches +, dominantly gray slightly compact very fine sandy clay.

The thickness of the profile layers varies somewhat from place to place. The plowed layer is dark grayish-yellow or grayish-yellow very fine sandy loam.

This type has good conservability and fair workability and productivity. It is strongly acid, and its supply of organic matter ranges from fairly low to moderately high. It is low in content of lime and phosphate and possibly other plant nutrients.

Owing chiefly to its imperfect drainage, this soil is suited to fewer crops than Hartsells fine sandy loam. Crops sensitive to wet conditions do poorly except in fairly dry growing seasons. Crops less sensitive to wet conditions, however, seem to be well adapted. So far as its profile characteristics are concerned, this soil could be easily drained, but it is in depressions where outlets might be a problem. In its natural state of drainage the soil is suited to hay crops and pasture. It is poor to fair cropland and good pasture land.

About 30 percent of the total area of this soil has been cleared. Of this, 50 percent is used for hay crops and pasture, 45 percent for corn, and the rest for other crops. Under the management commonly practiced, hay crops yield about ¾ ton an acre and corn about 25 bushels. Pasture yields well. Management required for the production of cultivated crops consists mainly of adequate drainage and proper fertilization, including especially phosphate. Lime should be beneficial to production.

Lickdale silt loam.—This poorly drained soil occurs in flats and shallow depressions on the Cumberland Plateau. The relief is level to nearly level (2 percent and less). External drainage is very slow to slow and internal drainage very slow. This soil has been formed from residual material of weathered sandstone and shale and from materials washed from soils underlain by sandstone and shale. In most places it has formed under grass vegetation. Its total area of 504 acres is associated chiefly with Hartsells, Johnsburg, and Atkins soils. The individual areas are small and widely scattered. Nearly all the soil is northwest of the Crab Orchard Mountains, the largest areas lying 4 to 6 miles northwest of Big Lick.

A profile of this type has the following characteristics:

0 to 7 inches, mellow silt loam, dark gray when dry and almost black when wet. This layer contains a fair quantity of decayed vegetation.
7 to 18 inches, grayish-yellow, mottled with gray and brown, slightly compact silt loam.
18 to 30 inches, gray, mottled with yellow, blue, and brown, slightly compact silt loam.
30 inches +, bluish-gray slightly compact silt loam.

The thickness of the profile layers varies somewhat from place to place.

This type has fair conservability and poor workability and productivity. It is strongly acid and is fairly well supplied with organic matter but is low in content of phosphate.

Except in protracted periods of dry weather, this soil is waterlogged; therefore, it is not suitable for most crops unless adequately drained. Problems of drainage vary from one area to another, but, in general, drainage would probably be infeasible because of the small size of the soil areas and in many places the difficulty of providing outlets for the water. This soil is poor cropland and fair pasture land. About 50 percent of the total area of this soil is used for pasture and a small total acreage for corn and hay crops, mostly hay. Fairly good yields of wild hay are reported, particularly in dry seasons when the hay crop is short on well-drained soils.

Very few, if any, areas of this soil have been adequately drained by artificial means. On areas adequately drained and properly treated with lime and phosphate, corn, small grains, and truck crops should produce fairly well.

Limestone outcrop.—Loose slabs of limestone and outcrops of limestone bedrock are so numerous that it is not economical to clear and fence this land for pasture, even where the slope is favorable. This land type consists of extremely stony land, and there is very little soil among the rocks, but what is present is a grayish-brown mellow silt loam layer about 6 inches thick, underlain by yellowish-red tough and tight silty clay a few to several feet in depth. The soil material is essentially that of the Talbott soils.

The relief is undulating to steep (5 to 50 percent), but it is predominantly between 15 and 40 percent. Nearly all the total of 691 acres is in Sequatchie Valley. Very little of the land has been cleared of forest for agricultural use. The forest consists of nearly pure stands of redcedar, but a few trees of other species occur where the quantity of soil is a little greater.

This land type has little value either for crops or for pasture because of the extreme stoniness and the scarcity of soil. Its most feasible use is for forest, although the quality of the timber grown is low.

Muskingum fine sandy loam.—This well to excessively drained soil occurs on the steeper slopes of the Cumberland Plateau. It is associated chiefly with Muskingum stony fine sandy loam and with soils of the Hartsells and Crossville series. It has been formed from weathered material of sandstone and some shale. The relief is rolling to hilly, the gradient of the slope ranging from 9 to 25 percent, but in most places from 12 to 14 percent. External drainage is medium to rapid and internal drainage medium.

A total area of 9,081 acres occurs mainly northwest of the Crab Orchard Mountains. These areas are medium in size and rather widely scattered. Practically all the soil is in forest of post, Southern red, and scarlet oaks, pine, and hickory.

Under virgin conditions, a profile of this type shows the following characteristics:

0 to 1 inch, gray very friable fine sandy loam containing a small quantity of organic matter composed of decayed leaves, twigs, and other vegetable matter.
1 to 7 inches, yellowish-gray very friable fine sandy loam containing only a small quantity of organic matter.
7 to 22 inches, yellow friable fine sandy clay.
22 to 27 inches, yellowish-gray very friable fine sandy loam mixed with small angular fragments of sandstone.
27 inches +, sandstone bedrock containing some shale.

The layers of the profile vary somewhat in thickness from place to place.

This type has fair workability and poor conservability and productivity. It is strongly acid, low in content of organic matter, and poorly supplied with mineral plant nutrients. It is easily pervious to moisture, air, and roots and has a low water-holding capacity. The soil is poor cropland and fair pasture land.

About 2 percent of the total area has been cleared. Of this about 40 percent is used for hay crops, 30 percent for pasture, 20 percent for corn, and the rest for wheat and rye. Under the management commonly practiced, hay crops yield about ½ ton an acre, corn about 13 bushels, and wheat and rye about 6 tons.

Largely because of its rather strong relief, shallowness to bedrock, and poverty of essential plant nutrients, this type is poorly suited to crops. Although the soil is naturally only fair pasture land, it is possible that the land could be managed so as to produce good pasture, providing such use is advisable in the farm program. The requirements for increased production are mainly liming and fertilizing. Such treatment would include the application of about 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre. To maintain the productivity of pasture, liming should be repeated at least every 10 years and phosphate every 4 years.

Included with this soil as mapped are small areas in which the surface soil consists of friable very fine sandy loam or silt loam and the subsoil of friable very fine sandy clay or silty clay loam. This included soil has been formed from weathered products of shale rather than from weathered products of sandstone as has Muskingum fine sandy loam.

Muskingum stony fine sandy loam.—This is the most extensive soil type in the county. The relief is rolling and hilly (9 to 30 percent). Both external and internal drainage are medium to rapid. The soil is derived from weathered products of sandstone and some shale. It differs from Muskingum fine sandy loam mainly in being stony, and it is associated with other Muskingum soils and with those of the Hartsells series. Probably less than 1 percent of the total area is cleared land. Forest, which covers practically all the soil, consists chiefly of post, Southern red, and scarlet oaks, Virginia and shortleaf pines, and hickory.

The total area of 151,914 acres occurs near the larger intermittent drains and small perennial streams on the Cumberland Plateau northwest of the Crab Orchard Mountains and on hilly interstream divides on the plateau southeast of the Crab Orchard Mountains.

In forests the profile of this type has the following characteristics:

0 to 1 inch, gray fine sandy loam that is very friable and contains a small quantity of decayed vegetation.
1 to 6 inches, yellowish-gray very friable fine sandy loam. Only a very small quantity of organic matter is in this layer.
6 to 22 inches, yellow friable fine sandy clay.
22 to 26 inches, light-yellow very friable fine sandy clay or fine sandy loam mixed with many small fragments of sandstone.
26 inches +, sandstone bedrock interstratified with varying quantities of shale.

The profile is extremely variable in depth to bedrock, ranging from 6 to 60 inches within distances of a few feet (pl. 3, *B*). Consequently, the thickness of the layers varies considerably. Sandstone fragments, 2 to 10 inches in diameter, are strewn over the surface and mixed throughout the profile. These fragments vary in quantity from place to place, but everywhere there are enough to make the soil stony. Sandstone boulders and outcrops of sandstone bedrock occur here and there.

The workability, conservability, and productivity of this soil are very poor. The soil is strongly acid and contains only a small supply of organic matter. It is rather low in content of mineral plant nutrients and is permeable to moisture, air, and roots but has a rather low moisture-holding capacity. The soil is very poor cropland and very poor to poor pasture land. Its best use is for forestry.

A few areas of this type have been cleared for agricultural use, most of them on north-facing slopes where a moderate quantity of organic matter has accumulated from the decay of leaves, twigs, and other vegetable matter. About 40 percent of the cleared land is used for pasture, about 30 percent for corn, 20 percent for hay crops, and nearly all the rest for wheat and rye. Under the management commonly practiced, crop and pasture production are similar to those of Hartsells fine sandy loam for 2 or 3 years, or until the virgin fertility of the soil is exhausted, after which the production becomes very low.

Under the management practiced, accelerated erosion generally reaches serious proportions in a few years, after which the soil is either pastured or is allowed to grow up with trees. Pasture on the seriously eroded soil is generally rather scant. Its productive period, however, may be prolonged by rotations in which close-growing crops are kept on the land for a rather long time. If this eroded soil is ever again planted to row crops, there is a strong possibility that it will be ruined for the production of crops of any kind, and that its use for pasture or forest will be greatly impaired.

Although this type is best suited physically to forest and its most feasible use seems to be for that purpose, the farm program may require the use of some of the less steep and less stony land. Such land would probably produce fair pasture if treated with about 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre, and this treatment repeated as often as the condition of the pasture requires.

Muskingum stony fine sandy loam, undulating phase.—This undulating phase is similar to the normal phase of this type in profile characteristics but differs from it in having a milder relief (9 percent and less) (pl. 5, *B*). External drainage is very slow to medium and

internal drainage medium. Only about 2 percent of the total area of 16,733 acres has been cleared. On the uncleared land the trees consist principally of post, Southern red, scarlet, and blackjack oaks, hickory, and pine. Most of this phase is northwest of the Crab Orchard Mountains and occupies positions along intermittent drains on the smoother parts of the Cumberland Plateau. In many places it occurs in long narrow strips flanked by other Muskingum soils and Hartsells fine sandy loam.

The conservability is fair, but the workability and productivity are poor. The soil is strongly acid, low in content of organic matter, and poorly supplied with essential plant nutrients. Moisture and air permeate the soil easily, and roots penetrate it freely. The water-holding capacity is fairly low. Being shallow to bedrock, the soil is rather susceptible to accelerated erosion. This phase is very poor to poor cropland and fair pasture land.

Of the cleared part of this phase, about 40 percent is used for crops, mainly corn, small grains, and potatoes, and the rest for hay crops and pasture. Under the management commonly practiced, corn yields about 10 bushels an acre, wheat and rye about 6, potatoes about 80, and hay crops about ½ ton. Pasture production is fairly low. In years when the rainfall is not well distributed over the growing season, yields of crops and pasture are somewhat less.

Largely because of its stoniness, shallowness to bedrock, and paucity of essential plant nutrients, this soil is poorly suited physically to crops and only fairly well suited physically to pasture. Nevertheless, on farms where the program makes the use of this soil advisable, fairly good pasture can be produced by the better practices of management, including an initial application of 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre. Smaller applications of these amendments would be required every few years to sustain the pasture.

Muskingum stony fine sandy loam, steep phase.—This phase differs from the normal phase of its type in having a stronger slope (30 to 60 percent), in being slightly shallower to bedrock, in having a little thinner surface soil, a slightly larger quantity of stone, and a slightly less developed profile. External drainage is rapid to very rapid and internal drainage medium to rapid. Practically all this phase is in forest, consisting of oak and a smaller proportion of pine. The total area of 28,670 acres is mostly on the Crab Orchard Mountains and in the southeastern part of the county associated chiefly with other Muskingum soils and Rough stony land (Muskingum soil material).

This steep phase has very poor workability, conservability, and productivity. It is strongly acid, contains only a small quantity of organic matter, and has a low content of mineral plant nutrients Owing largely to its strong relief, stoniness, shallowness to bedrock, and poverty of essential plant nutrients, this steep phase is very poor cropland and very poor to poor pasture land.

Only a small part of the total area has been cleared for agricultural use. A fairly large part of the land used for crops and pasture has been abandoned for such use and allowed to grow up with trees. Apparently, the most feasible use for this steep phase is forest. The

management requirements pertain to the production of forest rather than to crops and pasture.

Philo very fine sandy loam.—Derived from alluvial material washed chiefly from Muskingum and Hartsells soils, this imperfectly drained soil occurs in first bottoms near streams. The relief is level or nearly level (2 percent and less). The soil has slow to very slow external drainage and slow internal drainage—the drainage is intermediate between that of the well-drained Pope fine sandy loam and the poorly drained Atkins very fine sandy loam.

This soil is associated with soils of the Pope and Atkins series in bottom lands and with soils of the Hartsells series on the adjacent uplands. Its aggregate area of 2,023 acres is widely distributed over the county, with the principal areas in Grassy Cove and in the vicinity of Crab Orchard. In other places, this soil occurs in narrow strips along streams. A large total acreage has never been cleared for agricultural use.

A representative profile of this type has the following characteristics:

0 to 10 inches, grayish-brown or grayish-yellow friable very fine sandy loam containing a small quantity of organic matter.
10 to 21 inches, pale-yellow friable fine sandy clay.
21 to 36 inches, mottled gray, yellow, and brown friable fine sandy clay, a few rust-brown concretions in the upper part.
36 inches +, mottled gray, blue, yellow, and brown friable fine sandy clay material, the mottles somewhat larger than in the overlying layer; in some places thin strata of coarser textured material occur and in others thin strata of finer texture.

The layers of the profile vary somewhat in thickness from place to place.

This soil has good conservability and fair workability and productivity. It appears to have a rather low content of organic matter, is acid in reaction, and has a low supply of phosphate.

About 30 percent of the total area has been cleared, about 60 percent of which is used for hay crops and pasture, about 30 percent for corn, and most of the rest for small grains. The soil is fair cropland and fair to good pasture land. Under the management commonly practiced, hay crops produce about ¾ ton an acre and corn about 20 bushels. Yields of small grains are rather low. Pasture produces fairly well.

As the drainage is imperfect, this soil is not adapted to so many crops as Pope fine sandy loam, with which it is associated. Corn is subject to injury during wet periods, and 1 year out of about every 5 it is severely injured by too much moisture. Adequate underdrainage is an important problem in the management of this soil. The physical condition is such that, where feasible, artificial drainage may be effected. If artificially drained, this soil should be about the same as Pope fine sandy loam in crop adaptation and production. Except in unusually wet years, increased yields of crops may be expected from the use of lime and phosphate.

Included with this soil as mapped are about 50 acres of Philo silt loam, which is located east of Grassy Cove. This inclusion has a finer texture throughout the profile than the very fine sandy loam, which constitutes the main difference between the two soils. A few areas of soil similar to this type in profile characteristics and condition of

drainage occur on stream terraces. These areas are not subject to flooding and are a little better developed, but because of the small extent they are mapped as Philo very fine sandy loam.

Pope fine sandy loam.—Washed almost entirely from Muskingum and Hartsells soils, this soil has been formed from alluvial material. It occurs as rather narrow strips in bottom lands lying along both large and small streams and is overflowed occasionally. The soil covers a total of 2,430 acres, the areas being widely distributed over the county. It is generally associated with soils of the Philo and Atkins series of the bottom lands and with those of the Muskingum and Hartsells series of the uplands.

The relief is level or nearly level (2 percent and less). External drainage is slow to very slow and internal drainage medium. About half the total area is forested, mainly with different kinds of oak and with shortleaf pine, black tupelo (blackgum), sweetgum, and yellow-poplar. Most of the forested land is isolated, or nearly so, by steep nonarable soils of the Muskingum series.

A representative profile of this type has the following characteristics:

0 to 10 inches, grayish-brown or light-brown friable loose fine sandy loam containing a very small quantity of organic matter.
10 to 45 inches, light-brown or very light-brown heavy-textured fine sandy loam to loamy fine sand.
45 inches +, mottled gray, yellow, and brown friable fine sandy loam or loamy fine sand.

In many places the layers of the profile vary somewhat in thickness from that of the layers of the above profile. New material is added each time streams overflow the land; consequently, the soil as mapped varies somewhat in physical characteristics from place to place.

The workability is excellent, and its conservability and productivity are good. The soil is deficient in lime and phosphate, and it has a much lower organic-matter content than Huntington silt loam. It, however, responds well to good practices of management. The soil has good tilth, is easily penetrated by moisture, air, and roots, and has a good water-holding capacity. Moisture relations are favorable for the production of most of the crops commonly grown. The soil is good cropland and pasture land.

Owing to its favorable physical qualities, this type is one of the most desirable soils in the country for agriculture. It occupies, however, rather low positions near streams, and crops grown on it are subject to injury when the land is flooded.

About 40 percent of the total area of the cleared land is used for corn, 40 percent for hay crops and pasture, and the rest for small grains, truck crops, and other crops. Under the management commonly practiced, corn yields about 30 bushels an acre, hay crops about 1¼ tons, wheat and rye about 14 bushels, and potatoes about 150. Other crops and pasture produce well.

As this soil is low in content of lime and phosphate, the supplying of these elements is one of the main requirements of management. Properly treated with lime and phosphate, the soil should produce good yields of corn, clover, grass, cowpeas, and truck crops.

In some places, particularly near the streams, low ridges have formed, and the soil here is Pope loamy fine sand. To a depth of 35 inches or more this soil consists of light-brown loose almost inco-

herent loamy fine sand. Such soil is generally somewhat less productive than Pope fine sandy loam and is included with that soil because the areas are too small to show on the map.

Rolling stony land (Muskingum soil material).—Among the rock outcrops this soil is similar to Muskingum stony fine sandy loam but in general is somewhat shallower to bedrock. In most places outcrops of sandstone bedrock occupy 35 percent or more of the surface. Pockets occur here and there in which the soil is comparatively deep. Small seepy places are common. Near some streams precipices of rock are numerous, but they are too small to indicate on the map of the scale used.

The relief of this land type ranges from rolling to hilly, and the gradient from 9 to 30 percent. External drainage is medium to very rapid and internal drainage medium to rapid. Practically all the land is in forest, principally Southern red, post, and scarlet oaks, hemlock, yellow-poplar, and white, shortleaf, and Virginia pines. Pine and hemlock are generally predominant in the sheltered shady places and oak in the more exposed places. In general, the forest is considerably better than that on Smooth stony land (Muskingum soil material), which is probably because the soil is deeper to bedrock in many places.

Most of the 7,891 acres mapped occur along the main intermittent drains and the small perennial streams on the Cumberland Plateau. It usually occupies long, narrow bodies associated with types and phases of the Muskingum series and with Rough stony land (Muskingum soil material).

The workability, conservability, and productivity are very poor. This land type is very poor cropland and very poor pasture land—its most feasible use is for forest.

Rolling stony land (Talbott soil material).—Commonly referred to as rockland or limestone rockland, this land type has small outcrops of limestone bedrock occupying 10 to 50 percent of the surface. The soil material among these rock outcrops is similar to that of the Talbott soils. The relief is undulating to hilly, the gradient of the slope ranging from 5 to 25 percent, but in most places from 15 to 20 percent. External drainage is medium to very rapid and internal drainage medium to slow. A total of 1,228 acres is mapped, mostly in the Sequatchie Valley. A few areas are in Grassy Cove and in the coves near Crab Orchard.

The surface soil is grayish-brown friable silt loam or silty clay loam, underlain by a yellowish-red tough and tight silty clay or clay layer, ranging in thickness from a few inches to several feet. Immediately beneath this layer is limestone bedrock. Over most of this land type the outcrops of limestone bedrock protrude less than 12 inches above the surface. Some areas have been changed by accelerated erosion from rock-free land to the present condition of stoniness within about 50 years.

This land type has fair productivity, poor conservability, and very poor workability. The outcrops of limestone bedrock are numerous enough to render tillage infeasible generally. The area of the surface occupied by the rock outcrops and the depth of the soil material to bedrock vary considerably from place to place and largely determine to what extent the land is suitable for pasture. This land type is

regarded as very poor to poor cropland and fair to very good pasture land.

About 10 percent of the cleared area is used for crops, mainly corn and wheat, and the rest for pasture. Some of the best pasture on this land in Sequatchie Valley will provide grazing for one cow an acre from March 15 to November 15, providing the seasons are favorable. In many places this land type is used for shaded pasture. Indications are that thinly scattered black walnut and black locust trees aid the production of grass rather than retard it. Bluegrass and white clover are well adapted pasture plants, and pasture generally comes in early in spring. A relatively small part of the total area is in forest consisting mainly of different kinds of oak and hickory, yellow-poplar, black walnut, beech, elm, maple, and redcedar.

In most places rock outcrops prevent the use of mowing machines, and weeds offer a problem in the management of pastures. This problem, however, may be generally met in considerable degree by the judicious use of amendments.

Rough stony land (Muskingum soil material).—This land type includes areas of steep and broken land in which sandstone boulders and outcrops of sandstone bedrock are numerous over the surface. The land is predominantly steeply sloping, the gradient of the slope ranging from 30 to 60 percent. Soil among the rocks consists of Muskingum stony fine sandy loam, although its depth to bedrock is somewhat less in many places than is common for this type. External drainage is rapid to very rapid and internal drainage medium to rapid.

The aggregate area of 18,239 acres occurs mostly in the southeastern part of the county, mainly on the Crab Orchard Mountains, or escarpments in Grassy Cove and Sequatchie Valley, and along Piney Creek and its tributaries. Rather large areas of the land are in the northern part along the Obed River and Clear and Otter Creeks. Practically all of it is in forest, consisting largely of Southern red, post, and scarlet oaks, hemlock, yellow-poplar, and white, shortleaf, and Virginia pines.

This rough stony land has very poor workability, conservability, and productivity. It is very poor cropland and pasture land. Forest seems to be its most feasible use, although harvesting timber is rather difficult in many places, especially in the steeper and stonier areas.

Rough stony land (Talbott soil material).—This land type differs from Rolling stony land (Talbott soil material) primarily in that it occupies a stronger relief, or a relief in which the gradient of the slope is 25 percent or more. Because of the stronger relief, runoff has been greater and as a result more erosion has taken place and more bedrock has been exposed. Because of differences in relief these two land types are separated on the map. This hilly to steep land type has rapid to very rapid external drainage and medium to slow internal drainage. Erosion is very active in some places and causes the loss of considerable soil material.

Most of the 5,061 acres is on the slopes of the Crab Orchard Mountains, at the northeast and southwest ends of Grassy Cove, and on the slopes of Sequatchie Valley.

Conservability and productivity are poor and workability very poor. Chiefly because of its strong relief and the large proportion of the surface occupied by outcrops of limestone bedrock, this land type is very poorly suited to crops. Where the conditions of the individual farm make it advisable to use this land for pasture, it should produce fair to good pasture. The most feasible use for it is forest; therefore management requirements pertain to the production of forest rather than to crops and pasture. Forest covers a large part of the total area, the trees consisting principally of different species of oak, hickory, yellow-poplar, black walnut, beech, elm, maple, and redcedar. The proportion of redcedar is greater than on the Rolling stony land (Talbott soil material).

Smooth stony land (Muskingum soil material).—Outcrops of sandstone bedrock usually cover 30 percent or more of the surface of this land type. The soil among these outcrops is similar to Muskingum stony fine sandy loam, but in general it is more shallow to bedrock than any other soil on the Cumberland Plateau in this county. Small areas of seepy land occur in many places.

The relief is level to gently rolling, the gradient of the slope being 9 percent and less. External drainage is slow to rapid and internal drainage medium to rapid. The total of 426 acres is widely scattered over the county, the largest areas lying about 5 miles north of Crab Orchard and on the top of the Crab Orchard Mountains northeast of Crab Orchard.

Conservability is fair, workability poor, and productivity very poor. Stoniness and shallowness to bedrock cause this land type to be generally unsuitable for the production of crops and pasture. Its most feasible use is for forest, although the forest grown generally yields fairly poor timber. Practically all the land is forested, mainly with post oak, which occurs in open and nearly pure stands. The ground cover consists of native grass and a few shrubs and young trees. The grass affords some pasture. Management requirements include practices for the production of forest rather than for crops and pasture.

Talbott silt loam.—This well-drained soil on uplands is underlain by limestone. The soil is generally shallower to bedrock than Dewey silt loam with which it is associated. It has been formed from weathered material of argillaceous limestone. The relief is gently undulating to rolling, the gradient ranging from 2 to 15 percent. External drainage is slow to rapid and internal drainage medium to slow.

Most of the 523 acres mapped is in Sequatchie Valley, in association with other Talbott soils, with Rolling stony land (Talbott soil material), and with soils of the Dewey series.

In uneroded areas the profile has the following characteristics:

0 to 7 inches, grayish-brown mellow silt loam having a moderate content of organic matter.
7 to 18 inches, pale-red slightly compact silty clay.
18 to 32 inches, yellowish-red tough and tight heavy-textured silty clay.
32 to 50 inches, reddish-yellow, mottled with gray, yellow, red, and brown silty clay of tough and tight consistence.
50 inches +, bedrock of argillaceous limestone.

The depth of the profile to bedrock varies from place to place but averages about 60 inches. The layers of the profile also vary some-

what in thickness. Throughout the extent of this soil there is an occasional outcrop of the limestone bedrock and a few small fragments of limestone on the surface.

This soil has good workability, conservability, and productivity. It is shallower to bedrock, more subject to accelerated erosion, and less productive of most of the crops commonly grown than Dewey silt loam. It is strongly acid and is fairly well supplied with organic matter. The content of essential plant nutrients is probably moderately high. As the subsoil is heavy-textured, tough, and tight, the penetration of moisture, air, and roots in the soil is rather slow. The soil has a moderately low water-holding capacity. Cultivation is possible over only a fairly narrow range of moisture conditions. The soil is good cropland and good pasture land.

Nearly all the soil is cleared and used for crops and pasture. About 40 percent of the cleared land is used for hay crops, 30 percent for corn, 20 percent for pasture, and the rest for other crops, mainly small grains. In favorable seasons and under the management commonly practiced, corn produces about 30 bushels an acre, wheat about 16, and hay crops about 1¼ tons. Pasture is good.

Among the main requirements for the management of this soil are liming and fertilizing with phosphate. Increased production of crops and pasture should be obtained when the land is properly treated with lime and phosphate. Green manure or barnyard manure is beneficial to cropland.

Included with this soil as mapped are a few small areas of a soil from which a part or all of the surface soil has been removed by accelerated erosion. Such soil is indicated on the soil map by symbols that explain the character of the erosion. Included also are a few areas of a soil in which the subsoil is less tough and plastic and of lighter texture than the subsoil of Talbott silt loam. In physical characteristics the profile of this included soil approaches that of Fullerton silt loam but was included with Talbott silt loam because of its small extent and its similarity in other respects.

Talbott silty clay loam, eroded hilly phase.—This eroded hilly phase differs from Talbott silt loam chiefly in that it occupies a stronger relief (5 to 30 percent slope). The relief is predominantly hilly (15 to 30 percent slope), whereas that of the silt loam is gently undulating to rolling. Except that this hilly soil has lost a fairly large part to nearly all of its original surface layer through accelerated erosion, the profile characteristics of the two soils are practically the same. Differences in relief have affected to some extent the use and management of these soils. External drainage is medium to rapid and internal drainage medium to slow.

The total area of 698 acres is mostly in Sequatchie Valley associated with other Talbott soils and with those of the Dewey series. The soil has been formed from weathered material of several different kinds of limestone and colluvial materials of weathered rock and rock fragments.

This eroded hilly phase has fair productivity and poor workability and conservability. The cleared land has been affected by moderate and severe sheet erosion and in some places by gullying. Control of

water on the land constitutes one of the major problems in the management of this soil.

Owing largely to the strong relief and to erosion, this eroded hilly phase is poorly suited to cultivated crops but is fair pasture land. The most feasible use for areas affected by severe sheet erosion and gullying is forest. Trees on the forested land are mainly various oak, hickory, yellow-poplar, black walnut, beech, elm, and maple.

Probably 80 percent of the total area of this eroded hilly phase is cleared land used mainly for hay, pasture, corn, and small grains. About 60 percent of the cleared land is used for hay and pasture and the rest for corn and small grains. Under the common practices of management, hay crops produce about 1 ton an acre, corn about 18 bushels, and wheat about 10.

It would be feasible to crop this eroded hilly phase, providing long rotations, strip cropping, contour tillage, and other good practices are followed. Pasture, however, is apparently the best use for the moderately eroded land and forest for the severely eroded and gullied land. The pasture already on the land could doubtless be very much improved by an initial application of 2 tons of ground limestone and 400 to 600 pounds of 16-percent acid phosphate, or its equivalent, an acre. Continued production of improved pasture would probably require this treatment to be repeated every few years.

Several areas, comprising probably 20 percent of the total area, have not been cleared; consequently accelerated erosion has not affected the soil, which has a grayish-brown mellow silt loam surface layer about 6 inches thick. In several areas the subsoil is not so heavy-textured, tough, and tight as that of Talbott silt loam. In these areas the soil is generally cherty, and its profile is similar to that of Fullerton cherty silt loam, eroded hilly phase, which has a light grayish-yellow to yellowish-red cherty silt loam surface layer, a red or brownish-red firm but friable silty clay subsoil, and a mottled red, yellow, and gray friable substratum.

Talbott silty clay loam, eroded steep phase.—This phase includes steep areas of Talbott silt loam that have been moderately to severely eroded. Under forest cover, the surface layer consists of grayish-brown mellow silt loam, 5 or 6 inches thick. The subsoil is pale-red to yellowish-red tight and tough silty clay to a depth of about 24 inches, where it passes into reddish-yellow tough and tight silty clay mottled with gray, yellow, red, and brown. In cleared land one-half to practically all the surface layer has been removed by accelerated erosion, and gullies have formed in some places. Otherwise, this soil has profile characteristics similar to the uneroded soil in forested areas. It is derived from weathered material of limestone.

The relief ranges from 30 to 60 percent. External drainage is rapid to very rapid and internal drainage medium to slow. The total area of 607 acres occurs principally in Sequatchie Valley; a large part is in forest.

This phase has poor productivity and very poor workability and conservability. It is very poor cropland and poor pasture land. Much of the cleared land has been so severely affected by sheet erosion and gullies that forest seems to be its only feasible use.

About 50 percent of the total area of this phase was used for crops until erosion rendered the land useless for cropping, and then it was either used as pasture land or abandoned to forest. About 10 percent of the cleared land is still used for crops, mainly corn and small grains. In pastured areas the vegetation seems to hold sheet erosion in check, but gullies that started before the land was ever pastured have continued to increase in size but somewhat more slowly. Erosion would probably not become serious if the soil were put in permanent pasture as soon as cleared, and the pastures were not allowed to be overgrazed.

Included with the soil as mapped are areas in which colluvial material, consisting of weathered products of limestone and also fragments of the rock, has affected to some extent, the character of the profile. Included also are small areas in which the surface soil is light grayish-yellow to reddish-yellow cherty silt loam and the subsoil is red or brownish-red firm but friable silty clay, which is less tough and tight than that of the Talbott soils. This included soil is similar to Fullerton cherty silt loam, eroded steep phase, which is not mapped in this county.

Wolftever silt loam.—Formed on low terraces near streams from sand, silt, and clay, this silt loam has been washed from nearby uplands underlain mainly by limestone. Internal drainage is impeded by a tough plastic clay subsoil. The relief is very gently to gently sloping, the gradient ranging from 2 to 7 percent, although it is predominantly between 2 and 5 percent. Both external and internal drainage are medium to slow.

The total area of 123 acres is at the north end of Grassy Cove, associated chiefly with Dunning silty clay loam on the one side and Rolling stony land and Rough stony land (Talbott soil material) on the other.

A profile of this type has the following characteristics:

0 to 8 inches, light-brown or grayish-brown mellow silt loam containing a small quantity of organic matter.
8 to 20 inches, yellow or yellowish-brown tough plastic clay.
20 to 40 inches, mottled yellow, gray, and brown compact tight silty clay.
40 inches +, dominantly gray compact tight silty clay.

There is considerable variation from place to place in the thickness of the layers of the profile.

The workability is very good, and conservability and productivity are good. The soil is strongly acid, contains a rather low supply of organic matter, and is low in content of phosphate. The compact layer beneath the subsoil retards to some extent internal drainage and thereby narrows somewhat the range of the suitability of the soil for different crops. Most of the common crops, however, succeed. It is fair to good cropland and good pasture land.

All the soil has been cleared and used for corn, small grains, and hay. Under the management commonly practiced, yields of corn are about 50 bushels an acre, wheat about 19, and hay crops about 1¾ tons. This is one of the more desirable soils for the agriculture of the county. The use of lime and phosphate is among the main practices of management required for maintaining this soil in a high state of productivity.

PHYSICAL LAND CLASSIFICATION, MANAGEMENT, AND PRODUCTIVITY

The soils are classified in this section according to their desirability for farming, recommended management practices are described, and average crop and pasture yields under different levels of management are estimated.

PHYSICAL LAND CLASSIFICATION

The soils of this county differ widely in physical characteristics and consequently in their suitability to different uses and in the type of management they need. These characteristics include texture, structure, consistence, quantity and character of organic matter, chemical character (including reaction), moisture conditions, profile depth, accelerated erosion, stoniness, and slope or lay of the land. The soils are placed in classes that express their relative desirability for farming. The three general attributes of productivity, workability, and conservability determine the rank of the soils in this classification.

Productivity refers to the capacity of the soil to produce crops under prevailing farming practices. The soil may be productive of a crop but not well adapted because of its poor workability or conservability, or both. Workability refers to the ease of tillage, harvesting, and other field operations and is affected by texture, structure, consistence, moisture conditions, organic matter, stoniness, and slope, or lay of the land. Conservability refers to the ease with which the productivity and workability of the soil may be maintained and erosion controlled.

An ideal soil for crop production is very productive, easily worked, and capable of being conserved with minimum effort. A soil with such a combination of features is rare, if it exists at all. All the soils in the county fall short of that ideal, but they differ widely in the degree of such shortcoming. The various soils have been placed in five classes in descending order of desirability for agriculture.

Although the soils of no one class are ideal for the existing agriculture, the First-class soils are nearer than those of the Second-class. The soils of each succeeding class are farther from that ideal than those of the preceding class. The Fifth-class soils are, in general, less productive, less easily worked, and more difficult to conserve than those of any of the preceding classes.

The extent of the units making up each of these five classes is as follows:

First-Class Soils (0.1 percent):	*Acres*
Dewey silt loam	136
Rolling phase	84
Emory silt loam	168
Huntington silt loam	239
Total	627

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	Acres
SECOND-CLASS SOILS (22.1 percent):	
Crossville loam	5, 856
Hartsells fine sandy loam	71, 437
Deep phase	10, 839
Hartsells silt loam	3, 303
Holston fine sandy loam	775
Jefferson fine sandy loam	342
Pope fine sandy loam	2, 430
Talbott silt loam	523
Wolftever silt loam	123
Total	95, 628
THIRD-CLASS SOILS (17. 2 percent):	
Crossville loam:	
Rolling phase	8, 441
Shallow phase	1, 344
Hartsells fine sandy loam:	
Rolling phase	57, 380
Shallow phase	859
Hartsells silt loam, rolling phase	3, 542
Jefferson fine sandy loam, slope phase	355
Johnsburg very fine sandy loam	394
Philo very fine sandy loam	2, 023
Total	74, 338
FOURTH-CLASS SOILS (10.8 percent):	
Atkins very fine sandy loam	3, 865
Crossville stony loam	14, 271
Dunning silty clay loam	245
Lickdale silt loam	504
Muskingum fine sandy loam	9, 081
Muskingum stony fine sandy loam, undulating phase	16, 733
Rolling stony land (Talbott soil material)	1, 228
Talbott silty clay loam, eroded hilly phase	698
Total	46, 625
FIFTH-CLASS SOILS (49.8 percent):	
Hector stony fine sandy loam	937
Steep phase	666
Limestone outcrop	691
Muskingum stony fine sandy loam	151, 914
Steep phase	28, 670
Rolling stony land (Muskingum soil material)	7, 891
Rough stony land:	
Muskingum soil material	18, 239
Talbott soil material	5, 061
Smooth stony land (Muskingum soil material)	426
Talbott silty clay loam, eroded steep phase	607
Total	215, 102

FIRST-CLASS SOILS

First-class soils are good to excellent cropland and pasture land. They differ widely in degree of profile development, character of parent material, and in other respects but are similar in having favorable conditions of productivity, workability, and conservability. All are relatively well supplied with plant nutrients, compared with other soils of the county, but most crops on the most fertile soil respond to applications of amendments. None of the soils is very poor in lime (available calcium), although, except Huntington silt loam, the soils are slightly acid.

These soils are well drained, yet they retain moisture well, tending to insure an adequate supply for plant growth; hence growing crops withstand both excessive rainfall and drought. Good tilth is easily maintained, and the range of moisture conditions favorable for tillage is comparatively wide. These soils have a relatively high content of organic matter apparently well combined with the mineral material of the upper part of the soil profile. Their physical properties favor normal circulation of air and moisture, free penetration of roots, and growth of beneficial bacteria.

None of them is characterized by any prominent adverse soil condition. They are practically free from stones, their relief is favorable to soil conservation and tillage, and they are not severely eroded or highly susceptible to erosion. These soils are relatively high in productivity and are easily tilled. The problem of conserving their fertility and material is relatively simple. All are well suited to most of the exacting and intensive crops of the county when they are grown under the prevailing systems of management.

SECOND-CLASS SOILS

Second-class soils are fair to good cropland under present practices of farming and good to very good pasture land. They differ in a number of respects but not markedly in productivity, workability, or conservability. Each soil has, in moderate degree, one or more unfavorable characteristics, as poverty of plant nutrients, scarcity or poor assimilation of organic matter, or susceptibility to erosion. The detrimental effect of these characteristics is greater than that for any of the First-class soils but less than that for any of the Third-class. These soils are moderately productive of most of the common crops, and their physical properties are moderately favorable to tillage, circulation, and retention of moisture. All occupy a mild relief and are practically stone-free. They have good to excellent workability and can be conserved by feasible practices of management. In short, each soil is moderately deficient in one or more desirable characteristics but is not so deficient in any characteristic that it is poorly suited physically to use for the production of crops requiring tillage.

THIRD-CLASS SOILS

Third-class soils are poor to fair cropland and fair to good pasture land under prevailing practices of farming. Each soil is characterized by unfavorable conditions sufficient to lower considerably its physical suitability for the production of the common crops under practices now used. None of the adverse conditions, however, is so limiting that the soil is unsuited to cultivated crops. In these soils one or more of the following undesirable features is prominent: Poverty of plant nutrients, scarcity of organic matter, shallowness to bedrock, susceptibility to erosion, and slow internal drainage. These soils are better suited to crop production under prevailing systems of management than those of the Fourth Class but are less well suited than those of the Second Class. Their best use depends, among other things, on their location, the other soils of the farm unit, the type of farm, and economic conditions.

FOURTH-CLASS SOILS

Fourth-class soils are very poor to poor cropland and fair to very good pasture land under the prevailing practices of farming. Each soil is so difficult to work or to conserve, or both, that cultivation is generally not feasible. Each, however, is sufficiently fertile and has sufficiently good moisture relations that at least fair pasture can be maintained. In general, under the practices now used, these soils are best suited to pasture for which a large acreage is used, especially where adequate cropland is available. A very large acreage, however, is forested.

FIFTH-CLASS SOILS

Fifth-class soils are very poor cropland and very poor to poor pasture land. Each soil is so difficult to work or to conserve, or both, that under the prevailing system of farming cultivation is generally not feasible. Each soil is also sufficiently low in content of plant nutrients or has sufficiently poor moisture relations, or both, that pasture from the common pasture plants is generally scant. Even though forest trees may grow more slowly on most of these soils than on most of those of the four preceding classes, they are better suited to forest than to crops or pasture. Some farmers, however, who own little or no land of any other kind, have to use these soils for pasture or even for crops.

Each of the Fifth-class soils is characterized by one or more of the following undesirable features: Hilly, steep, or rough relief; high content of loose stones; numerous outcrops of bedrock; shallowness to bedrock; or accelerated erosion. In addition, many of these soils are apparently low in content of available plant nutrients and are strongly acid in reaction. Some of them have excessive drainage. As a result of these undesirable characteristics, the productivity for crops and pasture is generally low, or tillage with common farm implements is either impossible or very difficult. If the soils were used for crops, the requirements for their conservation would be very exacting. Although these soils are similar in suitability for use, they differ widely in many characteristics. Some of the differences may cause dissimilarities in the suitability of the individual soils for forest.

LAND USE AND SOIL MANAGEMENT

Proper use of land is a basic problem in the agriculture of the county. Although proper use inevitably changes, at least in detail, along with changes in transient social and economic conditions, the permanent productive use to which land is suited will be determined largely on the basis of permanent soil and land characteristics.

Past productive use has been determined to some extent by land features and soil characteristics. Misuse has been too common, however, and has resulted in damage, thereby affecting not only the individual owner but the community. The early settlers and some of the present-day farmers preferred to clear north-facing slopes for crop use, because a little more organic matter had accumulated on them and they were therefore slightly more productive than the others. As the sloping soils are shallow to bedrock, they are subject to much loss of material through erosion when cleared and cultivated. With

improved transportation facilities and with lime and commercial fertilizer available, there should be little need, under present economic conditions, for clearing the more sloping land for agricultural use.

In Grundy County, on soils essentially the same as those of the Cumberland Plateau part of Cumberland County, a long-standing settlement of German Swiss has demonstrated what can be done with soils of the type found on this plateau. These people have built up their land to a productive state chiefly by the use of manure and composts (*12*) and by the use of crimson clover as a cover and green-manure crop in the rotation. Land use is well adjusted, and only the comparatively level land is planted to row crops. The cleared sloping land is used for permanent hay and pasture, and several fields have been continuously in such use since about 1918. By top dressing with manure, a very good stand of grass, predominantly orchard grass and tall meadow oatgrass, is maintained.

The term "land use" refers to (1) tilled crops, (2) permanent pasture, and (3) forest. The problem of land-use adjustment is closely linked with that of soil management. The term "soil management" means (1) the choice and rotation of crops; (2) application of lime, commercial fertilizer, and manure; (3) tillage practices; and (4) engineering measures for the control of water on the land. The soils of Cumberland County differ widely in requirements concerning these practices.

In general, the choice and rotation of crops are probably the most important of these management practices, although all of them are important and interrelated. For convenience in this discussion, crops may be divided into (1) clean cultivated or intertilled, (2) close growing or those that require no cultivation of the growing crop, (3) permanent pasture, and (4) forest. In considering soil management it is desirable to use soils as intensively as is consistent with feasible maintenance of productivity.

In this county much of the land is in operated farm units. The use to which the land is put is determined not only by its physical suitability and the prevailing social and economic conditions of the region but also by factors peculiar to each farm, as its size, its operator's ability, and his facilities and resources. The problems of land-use adjustment and soil management vary from farm to farm and from time to time even on the same farm, and for this reason must be approached, at least in the main, through the individual operating units.

SOIL MANAGEMENT GROUPS

In the section on Physical Land Classification, the various soils were grouped according to physical suitability for agriculture as First-, Second-, Third-, Fourth-, and Fifth-class soils. The requirements of good management may be the same for some of the soils in the first two groups or the second and third group may contain soils that should receive the same treatment. The soils of these five physical land classes, therefore, have been regrouped according to their requirements for different practices of management as groups 1, 2, 3, 4, 5, 6, and 7.

In addition to the information given in the different management groups, more detailed information applicable to the agriculture of

Cumberland County may be obtained from bulletins and circulars of the Tennessee Agricultural Experiment Stations, as follows:

Bulletins:

101. The Rational Improvement of Cumberland Plateau Soils.
118. A Comparative Study of the Nitrogen Economy of Certain Tennessee Soils.
149. Fertilizers and Manure for Corn.
125. Stocker Cattle Problems on the Cumberland Plateau.
181. Potato Growing on the Cumberland Plateau.

Circulars:

34. Increasing the Profits from Phosphates for Tennessee Soils.
60. Fertilizers for Tennessee Soils.

GROUP 1

Group 1 includes Emory and Huntington silt loams. These two soils are fertile, productive, easily worked, and present little or no problem of conservation. They are suited to the most intensive use of any soil in the county. Cultivated crops can be successfully grown year after year in most places, and only very short crop rotations are necessary to maintain productivity.

With few exceptions, these soils are rich in lime (available calcium), and, as a rule, neither chemical fertilizer nor manure is applied to either of them for the common field crops. They can be tilled under a rather wide range of moisture conditions. As they are nearly level, there is practically no problem regarding contour tillage, erosion, or loss of water.

GROUP 2

Group 2 includes Dewey silt loam and its rolling phase and Talbott and Wolftever silt loams. Formed from limestone materials and occupying mild slopes of 4 to 12 percent, these soils are not severely eroded, the original surface soil being sufficiently thick to constitute most of the plowed layer.

Generally, the management requirements of these soils are similar. The soils are used for general farm crops including corn, wheat, some barley, hay, alfalfa, and tobacco. The soils can be conserved by rotations that include a legume crop, a cultivated crop only once every 3 years, adequate liming and fertilization, and proper tillage methods. All these soils are acid, and favorable results are obtained by applications, once during the period of the rotation, of 1 to 2 tons of ground limestone an acre for most crops, particularly alfalfa and clover. Mineral fertilizers, particularly phosphate, are needed to maintain productivity.

Tillage, especially on the stronger slopes, should follow the contour. Whether terraces or other engineering means of water control are necessary depends largely on the choice, rotation, and disposition of crops and on tillage and fertilization. On the stronger slopes proper terracing will doubtless be found advantageous in most instances, particularly where short rotations are practiced.

GROUP 3

Group 3 includes Crossville loam; Hartsells fine sandy loam and its deep phase; Hartsells silt loam; and Holston, Jefferson, and Pope fine sandy loams.

These soils are developed chiefly from weathered sandstone material and occupy mild slopes (0 to 5 percent). All the soils are extremely low in content of lime (available calcium) and phosphate. They are also low in content of humus, potassium, and nitrogen and possibly other constituents necessary to the proper growth of plants. Generally, the problem of conservation is primarily that of increasing and maintaining the fertility of the soils.

Applications of lime and phosphate bring about marked increases in the yields of crops on all these soils. In general, the soils are very responsive to needed fertilizers and amendments. So far as is consistent with the operating limitations of the individual farms, the choice and rotation of crops should, in most cases, be planned to increase the fertility of the soils and prevent accelerated erosion. A good crop rotation recommended by an extension specialist of the Tennessee Agricultural Experiment Station for the type of land on which these soils occur is the following: Potatoes fertilized rather heavily and planted early so as to be harvested by August 1, followed by crimson clover which should be seeded about August 1 and plowed under the following spring for green manure, at which time corn is planted. After the last cultivation of corn, a mixture of 8 pounds each of red clover and orchard grass, 5 pounds of Kentucky bluegrass, 3 pounds of redtop, and 1½ pounds of white clover should be seeded in the corn and should remain on the land for 2 or 3 years for use as hay or pasture. In years when red clover seed is exceptionally high in price, lespedeza could substitute for red clover in rotation.

GROUP 4

Group 4 includes the rolling phases of Crossville loam, Hartsells fine sandy loam, and Hartsells silt loam; and Jefferson fine sandy loam, slope phase.

Comprising another group having a large number of characteristics in common, these soils offer practically the same problems as the soils of group 3 so far as fertilizer and soil-amendment requirements are concerned. As they have stronger slopes (5 to 9 percent), their management requirements are more exacting. In addition to the necessity of increasing and maintaining the fertility of these soils, they need to be managed so as to reduce soil and water losses caused by excessive runoff. Long rotations are required for this, and it is important to keep a cover crop, preferably a legume, on the land during winter.

For use on these soils the county agricultural agent recommends the following rotation: Corn or potatoes; land planted to wheat in the fall and seeded in the spring to a mixture of 5 pounds of orchard grass, 6 pounds of lespedeza, 5 pounds of white clover, and 4 pounds of hop clover, to be used for hay or pasture for 3 years. Another rotation

recommended is corn or potatoes; land seeded as soon as possible in fall to crimson clover and in spring to a mixture similar to that mentioned above for use as hay or pasture for 3 years. Red clover and other legumes and grasses may be used or substituted for other plants in the mixture.

GROUP 5

Group 5 includes Atkins, Johnsburg, and Philo very fine sandy loams; Dunning silty clay loam; and Lickdale silt loam.

This group comprises soils of intermediate to poor drainage. The Philo and Johnsburg will produce crops in favorable seasons in their natural condition of drainage, but the Lickdale, Atkins, and Dunning cannot be depended on to produce cultivated crops unless artificially drained, although each produces good grass and pasture in its natural condition. All these soils except the Dunning are low in lime content (available calcium) and would probably be benefited by applications of lime and phosphate.

GROUP 6

Group 6 includes Crossville loam, shallow phase; Crossville stony loam; Hartsells fine sandy loam, shallow phase; Muskingum fine sandy loam; Muskingum stony fine sandy loam, undulating phase; Rolling stony land (Talbott soil material); and Talbott silty clay loam, eroded hilly phase.

These soils are physically unsuitable for the production of cultivated crops but are suitable for permanent pasture, though they differ to some extent for such use. Of these soils, all but Talbott silty clay loam, eroded hilly phase, and Rolling stony land (Talbott soil material) are low in content of lime, phosphate, and possibly in other constituents necessary to plant growth. Although experimental data are lacking as to the practicability of applying these constituents, it is highly probable that with liberal applications the soils could be used profitably for pasture. Although Talbott silty clay loam, eroded hilly phase, is not so low in fertility as the other soils, it doubtless would be benefited by applications of lime and phosphate. In general, management requirements for pasture are (1) fertilization, (2) liming, (3) regulated grazing, (4) clipping of ungrazed herbage, and (5) scattering of droppings or feed.

GROUP 7

Group 7 includes Hector stony fine sandy loam and its steep phase; Limestone outcrop; Muskingum stony fine sandy loam and its steep phase; Rolling stony land (Muskingum soil material); Rough stony land (Muskingum soil material); Rough stony land (Talbott soil material); Smooth stony land (Muskingum soil material); and Talbott silty clay loam, eroded steep phase.

An estimate of the soils of this county indicates that about 50 percent of the total area of the county is better suited physically to forest than to crops and pasture. Most of the present forest is on soils of this kind, although a large total acreage of the land now in forest would be suitable for crops or pasture if cleared.

The use of these soils cannot everywhere be adjusted to their best physical use suitability because of economic pressure on the farmers

who depend on them for a living. Although better suited to forest than to crops or pasture, they differ somewhat in suitability for growing forest. Thus, although Muskingum stony fine sandy loam and Rough stony land (Muskingum soil material) are suited only to forest, a better forest growth may be expected on the former than on the latter. In the production of forest, however, forest management is required more than soil management. It may be feasible, therefore, to subdivide the soils of this group on the basis of forest-management requirements but apparently not so feasible to do so on the basis of soil-management practices. For example, the kinds of trees, density of stand, and the methods of harvesting the timber are not the same for Muskingum stony fine sandy loam as for Smooth stony land (Muskingum soil material), although no particular difference in what might strictly be called soil management is generally recognized.

Most of the management practices employed in the production of forest might be grouped as follows: (1) Maintenance of a full stand of suitable species; (2) control of fire, browsing, trampling, and damage from the use of harvesting equipment and other harmful agencies; (3) systematic cutting and weeding; and (4) harvesting the mature trees in such a manner that they will be replaced by desirable species. Practices involved in the first, third, and fourth of these groups are concerned with forest management and those in the second group with both soil and forest management.

ESTIMATED YIELDS AND PRODUCTIVITY RATINGS

Average yields that may be expected from various crops are given for each of the soils of Cumberland County in table 13. For most of the crops three yields are given on each soil, corresponding to average expected yields under three different kinds of management. Average yields that may be expected vary widely, according to the way the soil and crops are managed, as management differs greatly from farm to farm. The yields in any one year may differ greatly from the average because of weather conditions, diseases, insects, and other factors.

TABLE 13.—*Estimated average yields per acre of the principal crops under each of three levels of management in Cumberland County, Tenn.*

[Yields in columns A are those to be expected without the use of fertilizer, amendments, or beneficial crop rotation. Those in columns B are to be expected under common practices of management; and those in columns C are to be expected under the best practices of management. Absence of yields indicates that the crop is not commonly grown because of poor adaptation.]

Soils [1]	Corn			Wheat			Timothy and clover			Lespedeza			Sorghum sirup			Potatoes			Sweetpotatoes			Permanent pasture		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*	*Gal.*	*Gal.*	*Gal.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Cow-acre-days* [2]	*Cow-acre-days* [2]	*Cow-acre-days* [2]
Atkins very fine sandy loam [3 4]	10	10	10				0.4	0.5	0.7	0.2	0.2	0.3										50	50	75
Crossville loam	15	25	40	5	10	15	.6	1.0	1.6	.6	1.0	1.3	30	60	90	60	100	180	75	90	150	35	60	85
Rolling phase	10	18	33	5	6	14	.5	1.0	1.5	.6	.9	1.1	30	60	80	50	100	150	68	90	102	25	50	75
Shallow phase	10	13	25	5	6	11	.5	.8	1.2	.5	.6	1.0	25	40	50	40	80	120	45	60	90	25	40	70
Crossville stony loam	10	13	25	4	6	11	.4	.6	1.0	.3	.5	.9	25	45	50	40	80	110	45	60	75	25	40	65
Dewey silt loam	30	35	50	18	20	28	1.4	1.6	2.0	1.2	1.4	1.7	[5] 75	[5] 75	[5] 75	160	180	200	120	135	150	90	90	130
Rolling phase	28	33	45	16	19	25	1.3	1.5	2.0	1.0	1.2	1.5	[5] 70	[5] 70	[5] 75	120	160	200	120	135	150	70	70	130
Dunning silty clay loam [3 4]	15	15	15				1.5	1.5	1.5	.8	.8	.8										100	100	100
Emory silt loam	40	45	55	15	20	25	1.5	1.8	2.0	1.2	1.5	1.7	[5] 90	90	[5] 90	120	150	180	120	120	150	90	90	130
Hartsells fine sandy loam	13	20	38	5	10	15	.5	.8	1.6	.6	.9	1.2	30	60	100	60	120	200	75	105	165	30	50	75
Deep phase	15	25	40	8	13	15	.6	1.0	1.6	.6	.9	1.3	30	70	110	70	130	200	75	113	180	30	50	75
Rolling phase	10	15	33	5	6	13	.5	.9	1.4	.6	.9	1.1	30	60	85	50	100	160	65	100	120	25	50	75
Shallow phase	8	10	25	5	6	11	.3	.5	.9	.3	.5	.9	25	45	50	40	90	110	45	60	75	20	35	60
Hartsells silt loam	15	25	40	7	13	15	.5	1.0	1.7	.6	.9	1.3	25	50	80	50	80	150	65	80	120	30	50	75
Rolling phase	13	18	33	5	6	14	.5	1.0	1.4	.6	.9	1.1	25	50	65	40	70	140	60	75	113	25	50	75
Hector stony fine sandy loam																						20	20	40
Steep phase																						15	15	30
Holston fine sandy loam	15	25	40	8	13	15	1.0	1.5	1.8	.8	1.1	1.4	70	80	90	100	150	200	90	120	165	50	70	80
Huntington silt loam [4]	50	50	55	10	10	13	2.0	2.0	2.0	1.5	1.5	1.5	[5] 100	[5] 100	[5] 100	[5] 100	[5] 100	[5] 100	90	105	120	150	150	150
Jefferson fine sandy loam	15	25	40	8	13	15	.6	1.0	1.6	.6	.9	1.3	30	60	110	80	150	200	75	113	180	30	50	75
Slope phase	13	20	35	5	8	15	.5	1.0	1.4	.6	.9	1.1	30	60	90	50	100	160	70	100	130	25	50	75
Johnsburg very fine sandy loam [3]	25	25	30				.6	.8	1.2	.6	.8	.9										50	75	90
Lickdale silt loam [3]	10	10	10																			50	50	75
Limestone outcrop																								
Muskingum fine sandy loam	8	13	25	5	6	13	.4	.6	1.0	.4	.5	.9	25	40	50	40	60	80	45	60	75	25	40	65
Muskingum stony fine sandy loam																						20	20	40
Steep phase																						15	15	30
Undulating phase	8	10	23	5	6	11	.3	.5	.9	.3	.5	.9	25	40	50	40	80	100	38	53	68	20	35	60
Philo very fine sandy loam [3 4]	20	20	25				.6	.8	1.2	.6	.8	.9										50	75	90
Pope fine sandy loam [3 4]	25	30	43	13	14	16	1.5	1.5	1.8	1.1	1.1	1.5	70	80	90	120	150	200	105	120	150	75	75	100
Rolling stony land:																								
Muskingum soil material																								
Talbott soil material							.6	.6	.6	.5	.5	.5										70	70	90

Rough stony land:																							
Muskingum soil material																							
Talbott soil material																					30	30	40
Smooth stony land (Muskingum soil material)																					15	15	15
Talbott silt loam	25	30	45	15	16	20	1.2	1.4	1.8	.9	1.0	1.4	55	60	70	100	120	140	75	100	120	65	75	120
Talbott silty clay loam:																							
Eroded hilly phase	13	18	20	8	10	15	.8	1.0	1.3	.6	.8	1.0	25	35	40	60	80	100	45	60	75	40	40	75
Eroded steep phase																						35	35	60
Wolftever silt loam	30	50	50	15	19	20	1.4	2.0	2.0	1.0	1.5	1.5	[5] 75	[5] 75	[5] 75	100	140	140	90	105	120	80	125	125

[1] Soils are listed in alphabetical order.

[2] Cow-acre-days, used to express the carrying capacity of pasture land, is the product of the number of animal units carried per acre multiplied by the number of days that animals can be grazed without injury to pasture; for example, a soil that supports 1 animal unit per acre for 360 days rates 360; a soil supporting 1 animal unit on 2 acres for 180 days rates 90; and a soil supporting 1 animal unit on 4 acres for 100 days rates 25.

[3] Estimated crop yields for this soil are for crops grown on undrained areas.

[4] Wheat, sorghum, potatoes, and sweetpotatoes are rarely grown on this soil; therefore yield data are extremely scarce, and those given were determined inductively.

[5] Quality of these crops is relatively somewhat inferior, taking the average of the county as a standard.

TABLE 14.—*Productivity ratings of soils under three levels of management for the crops most commonly grown in Cumberland County, Tenn., grouped by physical land classification* [1]

[Indexes in columns A refer to yields obtained without the use of fertilizer, amendments, or beneficial crop rotation; those in columns B to yields obtained under most common practices of management; and those in columns C to yields that may be expected under the best practices of management]

Soils [2]	Productivity index [3] for—																							
	Corn (100=50 bushels)			Wheat (100=25 bushels)			Timothy and clover hay (100=2 tons)			Lespedeza hay (100=1½ tons)			Sorghum sirup (100=100 gallons)			Potatoes (100=200 bushels)			Sweetpotatoes (100=150 bushels)			Permanent pasture (100=100 cow-acre-days) [4]		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
FIRST-CLASS SOILS																								
GOOD TO EXCELLENT CROPLAND AND PASTURE LAND																								
Huntington silt loam [5]	100	100	110	40	40	50	100	100	100	100	100	100	[6] 100	[6] 100	[6] 100	[6] 50	[6] 50	[6] 50	60	70	80	150	150	150
Emory silt loam	80	90	110	60	80	100	75	90	100	80	100	110	[6] 90	[6] 90	[6] 90	60	75	90	80	80	100	90	90	130
Dewey silt loam	60	70	100	70	80	110	70	80	100	80	90	110	[6] 75	[6] 75	[6] 75	80	90	100	80	90	100	90	90	130
Rolling phase	55	65	90	65	75	100	65	75	100	70	80	100	[6] 70	[6] 70	[6] 75	60	80	100	80	90	100	70	70	130
SECOND-CLASS SOILS																								
FAIR TO GOOD CROPLAND; GOOD TO VERY GOOD PASTURE LAND																								
Wolftever silt loam	60	100	100	60	75	80	70	100	100	70	100	100	[6] 75	[6] 75	[6] 75	50	70	70	60	70	80	80	125	125
Talbott silt loam	50	60	90	60	65	80	60	70	90	60	70	90	55	60	70	50	60	70	50	70	80	65	75	120
Pope fine sandy loam [5]	50	60	85	50	55	65	75	75	90	75	75	100	70	80	90	60	75	100	70	80	100	75	75	100
Holston fine sandy loam	30	50	80	30	50	60	50	75	90	50	75	90	70	80	90	50	75	100	60	80	110	50	70	80
Jefferson fine sandy loam	30	50	80	30	50	60	30	50	80	40	60	85	30	60	110	40	75	100	50	75	120	30	50	75
Hartsells fine sandy loam, deep phase	30	50	80	30	50	60	30	50	80	40	60	85	30	70	110	35	65	100	50	75	120	30	50	75
Crossville loam	30	50	80	20	40	60	30	50	80	40	65	85	30	60	90	30	50	90	50	60	100	35	60	85
Hartsells fine sandy loam	25	40	75	20	40	60	25	40	80	40	60	80	30	60	100	30	60	100	50	70	110	30	50	75
Hartsells silt loam	30	50	80	30	50	60	25	50	85	40	60	85	25	50	80	25	40	75	45	55	80	30	50	75
THIRD-CLASS SOILS																								
POOR TO FAIR CROPLAND; FAIR TO GOOD PASTURE LAND																								
Johnsburg very fine sandy loam [7]	50	50	60	----	----	----	30	40	60	40	50	60	----	----	----	----	----	----	----	----	----	50	75	90
Philo very fine sandy loam [5 7]	40	40	50	----	----	----	30	40	60	40	50	60	----	----	----	----	----	----	----	----	----	50	75	90
Jefferson fine sandy loam, slope phase	25	40	70	20	30	60	25	50	70	40	60	75	30	60	90	25	50	80	45	65	85	25	50	75
Crossville loam, rolling phase	20	35	65	20	25	55	25	50	75	40	60	75	30	60	80	25	50	75	45	65	75	25	50	75
Hartsells silt loam, rolling phase	25	35	65	20	25	55	25	50	70	40	60	75	25	50	65	20	35	70	40	50	75	25	50	75
Hartsells fine sandy loam, rolling phase	20	30	65	20	25	50	25	45	70	40	60	75	30	60	85	25	50	80	45	65	80	25	50	75
Crossville loam, shallow phase	20	25	50	20	25	45	25	40	60	30	40	70	25	40	50	20	40	60	30	40	60	25	40	70
Hartsells fine sandy loam, shallow phase	15	20	50	20	25	45	15	25	45	20	30	60	25	45	50	20	45	55	30	40	50	20	35	60

FOURTH-CLASS SOILS

VERY POOR TO POOR CROPLAND; FAIR TO VERY GOOD PASTURE LAND

Dunning silty clay loam [5 7]	30	30	30	----	----	----	75	75	75	50	50	50	----	----	----	----	----	----	----	----	----	100	100	100
Lickdale silt loam [7]	20	20	20	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	50	50	75
Atkins very fine sandy loam [5 7]	20	20	20	----	----	----	20	25	35	10	15	20	----	----	----	----	----	----	----	----	----	50	50	75
Talbott silty clay loam, eroded hilly phase	25	35	40	30	40	60	40	50	65	40	50	70	25	35	40	30	40	50	30	40	50	40	40	75
Rolling stony land (Talbott soil material)	----	----	----	----	----	----	30	30	30	30	30	30	----	----	----	----	----	----	----	----	----	70	70	90
Crossville stony loam	20	25	50	20	25	45	20	30	50	25	35	60	25	45	50	20	40	55	30	40	50	25	40	65
Muskingum fine sandy loam	15	25	50	20	25	50	20	30	50	25	35	60	25	40	50	20	30	40	30	40	50	25	40	65
Muskingum stony fine sandy loam, undulating phase	15	20	45	20	25	45	15	25	45	20	30	60	25	40	50	20	40	50	25	35	45	20	35	60

FIFTH-CLASS SOILS

VERY POOR CROPLAND; VERY POOR TO POOR PASTURE LAND; BEST SUITED TO FOREST

Talbott silty clay loam, eroded steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	35	35	60
Rough stony land (Talbott soil material)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	30	30	40
Hector stony fine sandy loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	20	20	40
Muskingum stony fine sandy loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	20	20	40
Hector stony fine sandy loam, steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15	15	30
Muskingum stony fine sandy loam, steep phase	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15	15	30
Smooth stony land (Muskingum soil material)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15	15	15
Rolling stony land (Muskingum soil material)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Rough stony land (Muskingum soil material)	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Limestone outcrop	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

[1] A grouping of the soils according to relative physical suitability for the general agriculture of the county.

[2] Soils are listed in the approximate order of their general productivity under prevailing practices.

[3] The soils are given indexes that approximate the average production of each crop in percent of the standard of reference. The standard represents the approximate average yield obtained without the use of fertilizer or amendments on the better soil types of significant extent in the regions in which the crop is most widely grown. Many ratings are the result of estimates, as supporting data are incomplete. Absence of indexes indicates that the crop is not commonly grown because of poor adaptation.

[4] Cow-acre-days, used to express the carrying capacity of pasture land, is the product of the number of animal units carried per acre multiplied by the number of days that animals can be grazed without injury to pasture; for example, a soil that supports 1 animal unit per acre for 360 days rates 360; a soil supporting 1 animal unit on 2 acres for 180 days rates 90; and a soil supporting 1 animal unit on 4 acres for 100 days rates 25.

[5] Indexes for crops grown on this soil are for crops grown on undrained areas.

[6] The quality of these crops is relatively somewhat inferior, taking the average of the county as a standard.

[7] Wheat, sorghum, potatoes, and sweetpotatoes are rarely grown on this soil, therefore yield data are extremely scarce and the indexes are arrived at inductively.

In columns A, the yields are those to be expected without special practices to restore, maintain, or increase productivity. No manure or commercial fertilizer and no lime or other amendments are used, and no special effort is made in the selection and rotation of crops or to return organic matter to the soils.

In columns B, the yields refer to those expected under present prevailing practices of soil management. The present general practice on soils of the Cumberland Plateau part of the county consists of light to medium applications of complete commercial fertilizer for potatoes and vegetables and light applications, or on some farms no application, for corn and small grains to be followed by hay crops. Phosphate alone is frequently used on corn, small grains, and pasture. Lime is used by many farmers on part of their land, and the quantity of lime and phosphate used is rapidly increasing. Neither terracing nor contour tillage is a common practice. Crops are rotated, but, in general, neither the selection nor the rotation of crops is well adjusted to soil needs. On the soils of the bottom lands the prevailing practices for many crops are the same as those shown in columns A.

In columns C, the yields are those that may be expected under the better practices of management, which consist of the choice and rotation of crops, the use of commercial fertilizer, lime, and manure, proper tillage, the return of organic matter to the soil, and, where necessary, engineering means of water and erosion control—all for the purpose of maintaining and increasing soil productivity but not to the point where increased costs would produce less than an equal increase in returns. On some of the fertile soils of the first bottoms, as Huntington silt loam, the better practices for several crops are the same as the prevailing practices; in fact, the more intensive farming practices produce little increase in the yields of crops, and the yields in columns A, B, and C are identical.

Yields obtained on soils unprotected from floods are the only ones given for soils of the flood plains, because no areas are definitely protected by dikes or levees. As the floods usually occur in winter and early in spring, they affect only winter crops to any great extent.

Factors influencing the productivity of land are mainly climate, soil (including drainage and relief), and management. Crop yields over a long period of years furnish the best available summation of those factors contributing to productivity, and they are used whenever data are available. In this county most of the information on crop yields is based on observation in the field, local expert advice, and consultations with farmers in the county and competent agricultural experts in the State. Because of a lack of definite data on past yields by soil types the yields given represent inductive estimates rather than arithmetic averages of measured yields.

Yields in columns C may be considered as production goals that might be generally attained by good practices of management. The same goals can probably be reached by several different combinations of the management practices listed above for any one soil and crop. Some of these practices may supplement or replace another; others are essential to good management. The best choice depends on the farm business as a whole. On one farm it may be advisable to manage the soil in such way that yields exceed the goals; on others it may not

be advisable to reach the goals. The best practical management for a farm unit may give yields in excess of the goal for one crop and soil and yields below the goal for another crop on the same soil.

In table 14 (pp. 76 and 77) the expected yields of various crops have been converted into indexes, and the soils are grouped according to their physical suitability for use.

The rating compares the productivity of each of the soils for each crop to a standard of 100. This standard index represents the yield of the crop without the use of fertilizer and other amendments on the more productive soils of that region of the United States where the crop is most extensively grown. An index of 50 indicates that the soil can be expected to yield about half as much, on the average, as the soil with the standard index without fertilizer or other amendments. Soils given amendments, as lime or commercial fertilizer, or unusually productive soils, may have productivity indexes of more than 100 for some crops.

The indexes in the productivity rating table are the expected yields in table 13 expressed as percentages of the standard yields adopted for the nation as a whole (productivity rating index $=\frac{\text{expected yield}}{\text{standard yield}}\times 100$). The standard yields on which the indexes are based are stated in the table under the name of the crops for which the ratings are given. Columns A, B, and C under each crop refer to three levels of management and correspond to similar columns in table 13, for which the levels of management are defined.

The ratings given in table 14 cannot be interpreted directly into land values. Distance to market, relative prices of farm products, association with other soils of different use suitability, and many other factors influence land values at specific places. These ratings, however, can be used for comparing the productivity for specific crops of different soils within the county and for comparing the productivity of the soils of the county with those of other parts of the United States; they can be used to show crop responses that may be expected from different levels of management; and they may be used with other information for estimating total production of crops by soil areas and also as a part of the information to assist in determining land values.

In table 14 the soils are listed according to the approximate order of their general suitability for the important crops of the present agriculture under current practices. For the lack of more definite data, this has been done chiefly on the basis of information acquired through field observation, local expert advice, and through consultations with farmers in the county and with competent agricultural specialists in the State.

WATER CONTROL ON THE LAND

The discussion of water control on the land is restricted to the control of runoff and to artificial drainage, as neither irrigation nor the control of flooding by such measures as dikes is significant in the present agriculture of this county. The control of runoff is a more important problem than artificial drainage, especially from the standpoint of acreage. To some degree it is a problem on most of the

cleared uplands and terraces, or on a total of about 35,000 acres, which is about 8 percent of the total area of the county. On the other hand, about 7,000 acres, or about 1.6 percent of the total area, require artificial drainage to establish moisture conditions suitable for tilled crops. Soils requiring control of runoff occur on the uplands and terraces in all parts of the county.

These two types of water control mean much to the agriculture of the county. The control of runoff has far-reaching effect on soil conservation and crop production, as it is needed on most of the cleared land. Artificial drainage, where needed, would greatly broaden the range of suitability of the Atkins, Lickdale, and Dunning soils, which in their natural state of drainage, are suitable only for pasture and forest. Where artificially drained, however, practically all of their area would be suitable for corn, hay, and most of the other important crops of the county.

CONTROL OF RUNOFF

Failure to control runoff in this county has resulted from failure to adjust the use and management of the land to the natural characteristics of the soils. Although accelerated erosion is only one of the results of failure to control runoff, it shows the extent to which runoff has not been controlled in this county. The control of erosion is not in every case the most important result from the control of runoff.

Most of the land of high natural fertility was cleared soon after the first permanent settlements were made in Cumberland County. During the last 100 years accelerated erosion has been active. As the mean annual rainfall is about 55 inches and the prevailing relief of the more productive land is rolling to hilly, it is estimated that more than 90 percent of the cultivated land has been sufficiently eroded to impair productivity or workability, and in many places both.

Nearly 90 percent of the total land area has remained in forest, and the runoff has been largely controlled by the cover of natural vegetation. The problem of runoff control, therefore, does not apply to so great a total area in this county as in most of the counties in the Great Valley of east Tennessee. Nevertheless it is very important because of the general shallowness of the soils to bedrock. The loss of 6 inches of soil from most soils in the Great Valley of east Tennessee, where the soils are comparatively deep, means that only about one-fiftieth of the profile has been removed, whereas in Cumberland County such a loss means for most of the soils that about one-sixth of the profile has been removed. As soon, therefore, as land in Cumberland County is cleared and used for crops, close attention should be given to the control of runoff, for if it is not controlled when the land is cleared for cropping the whole area will become seriously eroded.

The land derives many benefits from the control of runoff, among which are (1) a better supply of moisture for growing crops, (2) improved conditions for tillage, particularly in periods of low rainfall, (3) better conditions for biological activities, (4) improved conditions for the formation of humus, and (5) control of accelerated erosion.

The correction of unduly rapid runoff lies in the readjustment of land use and soil management. As the land on which most of the uncontrolled runoff occurs is operated in small farms, such readjustment

must be made in accordance with the limitations and requirements of both the farm and the farm operator. The farmer who attempts to control runoff through readjustment in land use and soil management is confronted with a number of problems that directly or indirectly limit his farm-management program. Among these are (1) the size and type of farm; (2) the physical character of the land, including the soil pattern of the farm; (3) the surrounding social and economic conditions, as transportation and markets; (4) the immediate cash demand on the farm income for such items as taxes, indebtedness, and support of family; (5) community cooperation in the use of farm machinery and in drainage, water disposal, marketing, and buying; and (6) farm tenure. It is practicable on most farms, however, to introduce crop rotations involving close-growing crops and winter cover crops and to keep pastures in a condition of good vegetative cover so as to reduce runoff materially.

DRAINAGE

Drainage is restricted to soils whose natural drainage is inadequate for crops. A total of about 7,000 acres in the county needs artificial drainage, and nearly two-thirds of this land is too poorly drained naturally for crop use. The poorly drained soils occur mainly in the bottom lands along the streams. The remaining acreage is sufficiently drained naturally for corn and some other intertilled crops. Drainage is inadequate for many crops, however, and artificial drainage would materially improve the productivity of the soils and broaden their suitability for use. The Dunning, Atkins, and Lickdale soils are in great need of drainage, and though the Philo and Johnsburg can be used for certain crops they would be greatly improved by artificial drainage. If adequately drained, the Dunning soil would be much more productive than any of the other soils needing drainage.

The feasibility of draining these soils can hardly be discussed from the standpoint of the 7,000 acres as a whole. Artificial drainage has been established in a very small total acreage, and its practicability depends on a number of factors, as the conditions of drainage differ from place to place. Owing to the friable consistence and easy permeability of the Philo, Atkins, Lickdale, and Johnsburg soils, they should drain well artificially, where engineering measures are feasible. Although the consistence and structure of the Dunning soil make artificial drainage more difficult than for the other soils, the returns brought about by adequate drainage should be much greater. No adequate studies have been made as to the engineering phase of drainage.

SOIL ASSOCIATIONS

The soil map accompanying this report shows that the soil types of Cumberland County occur in complicated patterns. Small bodies of different types are found in close intermixture with one another. Almost every farm has a mixture or association of soils, some good and some poor, some shallow and some steep, some stony and some smooth. Nearly every farmer, therefore, has the problem of handling, not one or two, but several soil types. He has to plan his field layout and cropping system so as to get the most out of the particular com-

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bination of soils on his farm. If he has a few pieces of productive soil with gentle slopes, he will generally try to crop these as heavily as he can and keep his corn and other row crops on them and use the steeper soils for pasture, hay, and forest. If the smooth, lower lying soils are poorly drained, however, they may be used for pasture and the steeper ones planted to corn in a rotation that will protect the soil from washing and maintain its productivity as much as possible.

Each farm will have a somewhat different combination of soils. Most farms in certain areas of the county will have about the same types in their combination, while most of those in another part will have different soil types. In some areas, for example, farms will have Hartsells, Crossville, and Lickdale soils; in others Muskingum, Hartsells, Crossville, Pope, Philo, and Atkins; and in still others Dewey, Talbott, and Emory. The results obtained from a test of new fertilizer and liming practices, cropping practices, farming systems, or drainage methods on a farm will mean something to farmers having about the same soils in combination but may mean little or nothing to farmers having a different set of soil types. When trials of farming methods therefore are made on test or demonstration farms, it will be easier to see where the results are likely to apply if it is known where the farms are situated that possess about the same associations of soil types. Furthermore, when farmers try out new methods or are assisted in putting them into effect for demonstration purposes, the objective of the effort will be served more fully if a test or demonstration is made in every important area having a distinct pattern or association of soils. Thus, each important soil association that farmers have to use would be represented.

The areas having a characteristic pattern or association of soil on the soil map are delineated to aid in the selection of farms representative of each area. Figure 3 shows areas of this kind delineated in Cumberland County, based on the pattern of soils shown on the county soil map. This map of soil association areas may also be helpful in community or regional studies that require a separation of a county into geographic subdivisions of relatively uniform physical character. It may aid in the placement of highways, power lines, industries, including agricultural processing facilities, and in the organization of community services generally.

The soil association map should in no sense replace the detailed soil map. Instead, it is designed to aid the user of the detailed map in perceiving the relatively broad areas, each of which is made up of about the same combination of soil types.

HARTSELLS-CROSSVILLE

The Hartsells-Crossville association occurs on the Cumberland Plateau, principally on the broader less-dissected divides. The larger areas are on the divides between the drainage basins of the Tennessee and Cumberland Rivers. The Hartsells soils are the most important agriculturally and the most extensive, but the Crossville are of considerable importance agriculturally. Muskingum soils are extensive but of less importance than the other soils to the agriculture of the area.

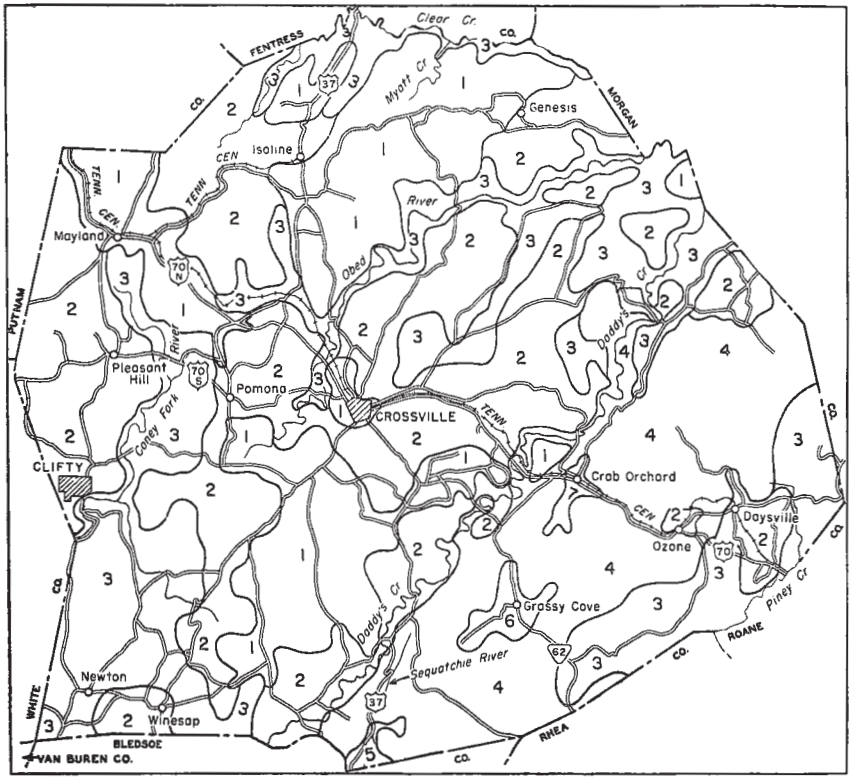

FIGURE 3.—Soil associations in Cumberland County, Tenn.: 1, Hartsells-Crossville; 2, Muskingum-Hartsells-Crossville; 3, Muskingum-Hartsells; 4, Muskingum-stony land (Muskingum soil material); 5, Dewey-Talbott-Emory; 6, Talbott-Wolftever-stony land (Talbott soil material); 7, Holston-Jefferson-stony land (Talbott soil material). (Small diagonally hatched area on western boundary a part of White County: see map, cover page 3, for detail.)

Throughout this association the areas are weakly dissected but have a well-defined dendritic pattern of drainage. They are predominantly undulating to rolling, but stronger slopes occur along the major drains. These areas are underlain chiefly by sandstone, but in some places by shale, and the soils are derived from weathered products of these rocks. In general, the depth to bedrock is greater than in any other soil association of the Cumberland Plateau in this county.

In this association, Hartsells soils occur typically on the broad smooth ridge crests, Hartsells or Crossville on the gentle to moderate slopes, and Lickdale soil along the narrow drainageways in alluvial-colluvial areas. Crossville soils also occur in places on smooth ridge crests. This association has no significant acreage of soil on the bottom lands.

A large part of this association—50 percent or somewhat more—is physically suitable for crops. Second-class soils predominate in the crop-adapted part and Fifth-class soils in the part unsuitable for crops. The Hartsells and Crossville are suited to crops but are naturally very

low in fertility. They have relatively mild slopes and favorable properties for the maintenance of good tilth; consequently, they are easily worked. The Muskingum soils are steep, stony, shallow, low in fertility, and poorly suited either to crops or pasture.

Farms on this association are generally the subsistence type, but there are a number of small general farms. Livestock and potatoes are the principal sources of cash income. Vegetables for market have become more important in recent years. In general farms are small, and the small cleared area per farm is used rather intensively for crops. Livestock is pastured chiefly on open range.

The area covered by this association is the most highly developed of any on the Cumberland Plateau in this county. A large part of the land usable for crops, however, is undeveloped, and this area possibly offers the best opportunity for development of any part of the county. Increased production can be expected both from clearing new land and from better management practices, including heavier fertilization.

MUSKINGUM-HARTSELLS-CROSSVILLE

Land in the Muskingum-Hartsells-Crossville association is more highly dissected than in the Hartsells-Crossville association, and there is a greater proportion of Muskingum soils and a smaller proportion of Hartsells and Crossville. The Hartsells soils are the most important agriculturally, although the Muskingum are more extensive. A small but significant acreage of soils of alluvial origin—Pope, Philo, and Atkins—occur in this association.

In this area the drainage system is dendritic. Streams are deeply entrenched and close together, and ridge tops are narrow. Sandstone and shale are the underlying rocks, though small outcroppings of the shale appear here and there. The depth of soils to bedrock is generally less than in the Hartsells-Crossville association. Typically, Hartsells soils occupy the smooth ridge crests, Crossville or Hartsells the gently sloping or sloping ridge crests, and Muskingum the strong or steep slopes, while the Pope, Philo, or Atkins soils are in the bottom lands along the major streams.

Between 25 and 50 percent of this association is suitable for crops. Second- and Third-class soils are about equally extensive in the crop-adapted part, and Fifth-class soils predominate in the part not suitable for crops. No First-class and only a relatively small acreage of Fourth-class soils are in this association. The Muskingum soils are very poorly suited to crops and pasture, and, although poorly suited to the production of timber, forest is probably their most feasible use. The Hartsells and Crossville are physically suited to crops but naturally very low in fertility. The inextensive Pope and Philo are well suited to agriculture.

Subsistence farming is practiced on this association. Practically all the crops are used on the farm where grown, although a few potatoes and vegetables are marketed. A few livestock are kept by most farmers and grazed chiefly on the abundant acreage of open range. Some cash income is derived from the sale of livestock and livestock products.

A very small part of this association along the principal roads and in the vicinity of Crossville has been cleared. The area covered by this association offers considerable opportunity for agricultural development but possibly less than that covered by the Hartsells-Crossville association, and though 25 to 50 percent is suitable for crops, most of the land will require clearing. Liberal fertilization, even on newly cleared land, is generally required for satisfactory crop yields on most areas.

MUSKINGUM-HARTSELLS

The Muskingum-Hartsells association, occupying highly dissected areas underlain chiefly by sandstone, differs from the Hartsells-Crossville and the Muskingum-Hartsells-Crossville associations chiefly in having a much larger proportion of Muskingum, Pope, Philo, and Atkins soils and a smaller proportion of Hartsells soils. Crossville soils are relatively not extensive.

In the areas of this association the streams have carved deep closely spaced valleys that have narrow ridge crests. In general, the soils are very stony and also shallow over bedrock. In most places Hartsells or Crossville soils occupy the ridge crests and Muskingum soils the stronger slopes, with Pope, Philo, and Atkins occurring in the bottom lands along the larger streams.

Only about 20 percent of this association is suitable for crops, much of it occurring in small bodies surrounded by soil not suitable for crops, and a very small part of the land has been cleared. This association offers much less opportunity than the Hartsells-Crossville and the Muskingum-Hartsells-Crossville associations for agricultural development. In several places it lies adjacent to the former association but in most places is surrounded by the latter, which has a large proportion of land unsuited to crops.

MUSKINGUM-STONY LAND (MUSKINGUM SOIL MATERIAL)

The Muskingum-stony land (Muskingum soil material) association, extending over a large part of the Crab Orchard Mountains, is characterized by hilly to steep relief and much stony land. It is comprised chiefly of soils of the Muskingum series and land types of stony land (Muskingum soil material). A very small acreage of Hartsells and Crossville soils occurs on the narrow ridge crests, and a very small acreage of Pope, Philo, and Atkins soils in the bottom lands along the larger streams.

Fourth- and Fifth-class soils predominate in this association. In most places small areas of Second- and Third-class soils are isolated by large areas of Fifth-class soils. Very little agricultural development has taken place. An abundance of open range, however, constitutes the main inducement to further settlement. This association is probably best suited to forest and recreation.

DEWEY-TALBOTT-EMORY

The Dewey-Talbott-Emory association lies entirely within the Sequatchie Valley. Soils of the Dewey series are the most extensive as well as the most important agriculturally. Other soils in the order

of decreasing extent are the Talbott, land types of stony land (Talbott soil material), Huntington, Emory, and Limestone outcrop.

The area covered by this association is predominantly undulating to rolling, but there are moderately steep slopes in the outer parts. Dewey or Talbott soils occupy the undulating or rolling uplands, Emory soils the colluvial lands, Huntington soils the bottom lands, and Talbott soils and land types of stony land (Talbott soil material) the hilly and steep uplands.

The soils of this association are naturally fertile and productive, compared with the soils of low fertility on the Cumberland Plateau. The Dewey, Emory, Huntington, and smooth stone-free Talbott soils are well suited to a wide variety of crops. They are, however, less easily tilled than the light-textured soils of the Cumberland Plateau. Large areas of the Talbott soils are stony enough to make cultivation of row crops impractical; however, these stony areas and the hilly Talbott soils are well adapted to pasture.

Soils in the Sequatchie Valley have been favorable for the development of a highly diversified agriculture, including some specialization in the production of livestock, particularly beef cattle. Practically all the land in this valley has been cleared and cultivated for a considerable length of time. Many of the soils have been moderately eroded, and some of the strongly sloping Talbott soils have been severely eroded.

TALBOTT-WOLFTEVER-STONY LAND (TALBOTT SOIL MATERIAL)

The Talbott-Wolftever-stony land (Talbott soil material) association is in Grassy Cove and is underlain chiefly by limestone, but sandy alluvial and colluvial materials washed from mountain slopes have covered most of it. It is comprised of a large number of soils, including principally members of the Talbott, Wolftever, Pope, Philo, Atkins, Dunning, Huntington, Holston, Jefferson, Emory, and Hartsells series, and land types of stony land (Talbott soil material), but none is very extensive.

The area occupied is nearly level to gently rolling, except a sloping or strongly sloping belt around the outer part in which Talbott soils and land types of stony land (Talbott soil material) are predominant. Soils of the Jefferson series occur in many places; Hartsells and Talbott soils on the undulating uplands in the center of Grassy Cove; Holston and Wolftever soils on the terrace lands; and Huntington, Dunning, Pope, Philo, and Atkins soils on the bottom lands.

Second-, Third-, and Fourth-class soils are about equally extensive in this association, which contains only a very small acreage of First- and Fifth-class soils. The soils differ widely in suitability for crop use. The Holston and Hartsells soils are physically well suited to such use but are naturally low or very low in fertility. The Talbott and Wolftever soils are fertile and moderately productive but are more difficult to till than the Hartsells soils; although the Huntington and Pope soils are fertile, floods limit their suitability for crops. The suitability of the Atkins, Dunning, and Philo soils for crops is restricted by slow or very slow internal drainage and by floods.

Practically all the land of this association has been cleared and is used for crops and pasture. Much of it is in large farms that specialize in livestock, particularly beef cattle.

HOLSTON-JEFFERSON-STONY LAND (TALBOTT SOIL MATERIAL)

The Holston-Jefferson-stony land (Talbott soil material) association is covered chiefly by alluvial or colluvial materials washed from areas of sandstone. In this association Holston and Jefferson soils are the most important agriculturally. Land types of stony land (Talbott soil material) are extensive; other soils of less extent and importance are members of the Talbott, Philo, Atkins, and Dunning series.

The area comprising this association has a relief similar to that of Grassy Cove, which is undulating to rolling in the central part and strongly sloping in the outer. The land types of stony land (Talbott soil material) are mostly on the strongly sloping outer part; Holston and Jefferson soils on most of the central part; and Philo, Atkins, and Dunning soils in the bottom lands.

The Holston and Jefferson soils are suited physically to a wide variety of crops but are moderately low in fertility. The Philo, Atkins, and Dunning soils have slow or very slow internal drainage and are also subject to flooding. These conditions limit the suitability of these soils for crops, and they are considered best suited to pasture. The land types of stony land (Talbott soil material) also are considered best suited to pasture. General farming with some specialization in livestock is practiced on this association.

FOREST [8]

Cumberland County, included in the Indian Territory and inhabited by Cherokee Indians, was traversed by the road connecting Fort Blount at the junction of Flynns Lick Creek with the Cumberland River and West Point where the Clinch River joins the Tennessee River. In 1802 this travel route was broad and commodious because of the very large number of emigrants traveling to settle in the West. Wild turkeys, 30 or 40 in a flight, grapes, chinquapins, a species of small chestnuts, superior in taste to those in Europe, and venison and wild fowl were described in Cumberland, the name of this entire region. In this part of Tennessee the forests were composed of all the species of trees that belong to the mountainous regions, including oak, maple, and nut trees. Pines were common in those parts with the poorest soil. Rather commonly, parts of the woods for the space of several miles were found where all the pines, which formed at least a fifth of the trees, had been dead since the preceding year but still kept all their withered foliage. An explanation of this is recurring epidemics of the southern pine bark beetle, at that early date referred to as bugs or worms (*15*).

The first large wave of settlers came to Cumberland County following the Civil War. The first herd of cattle driven into Grassy Cove in 1869 was evidence of the optimism that led Samuel Kline to haul from the railroad at McMinnville the plateau's first steam-powered sawmill and gristmill. The pioneers were followed successively by the land speculators in the 1880's and 1890's, the railroad promoters, the lumbermen, and the Cumberland homesteaders in 1934. The need for transportation and communication with the outside early became a problem. The last spike was driven in the Tennessee Central Rail-

[8] Prepared by G. B. Shivery, extension forester, University of Tennessee.

way in May 1900, and two locomotives met at the Obed River. A new kind of exploiter, the lumberman, arrived simultaneously with the railroad and for 20 years cut the timber, tanbark, and acid wood, hauling them to the railroad from all parts of the county.

Eighty-six percent of the area of the county is in forest (fig. 4).

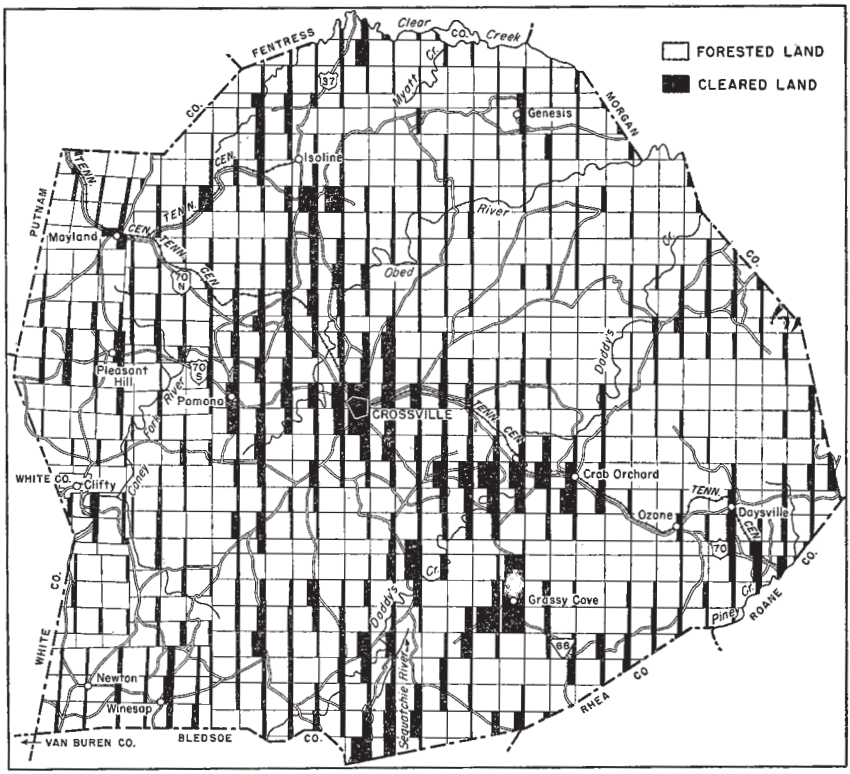

FIGURE 4.—Proportion by approximate square miles of forested and cleared land in Cumberland County, Tenn., in 1936.

Of this, 71,900 acres, or 19 percent, is classed as farm woodland (*14*), compared with 17 percent indicated by the census of 1910; 68 percent is classed as private nonfarm forest; and 13 percent public-owned forest. According to the number of farms reporting woodland (1940 census), the average acreage of farm woodland is 45. Farmers, however, actually exert more influence over the forest land than the figures of land ownership indicate. Cumberland County has open range, and the farmers' cattle and other livestock graze on much of the land owned by corporations and nonresident individuals.

The most common forest type in the county is the blackjack oak-hardwoods, which makes up 52 percent of the forest area. Other types in order of extent are the yellow pine-hardwoods, comprising 24 percent of the forest area; the upland hardwoods, 15 percent; and other types, including yellow pines, white pine-hardwoods, hem-

lock-white pine, hemlock-hardwoods, and cedar-hardwoods, the remaining area.

Most of the cedar-hardwoods type is on soil association 5 (fig. 3, p. 83), especially on Rough stony land (Talbott soil material) and Limestone outcrop, practically pure stands of redcedar being on the latter. The hemlock-hardwoods type, with occasional pure hemlock, occurs in bottom lands on soil association 3, particularly along the Obed River, and the hemlock-white pine type is along Piney Creek, the lower courses of Daddy Creek, and tributaries of the Obed River. The white pine-hardwoods type occurs on soil association 3 with the hemlock-hardwoods and hemlock-white pine types. Hemlock, white pine, yellow-poplar, basswood, white oak, Northern red oak, and in places shortleaf pine or Virginia pine are associated with Rolling stony land (Muskingum soil material) and Rough stony land (Muskingum soil material) in the gorges of permanent and intermittent streams. No native white pine, however, exists west of the Crossville-Jamestown highway except along Clear Creek.

The yellow pine-hardwoods type, interspersed with pure yellow pine, occupies those parts of soil association 3 not in the gorges and occurring in the eastern part of the county. It extends from the borders of the gorges and merges either with the blackjack oak-hardwoods type or the upland-hardwoods type. Pure stands of pine, usually Virginia pine, predominate, though scattering shortleaf pines occur throughout the county. These trees come in on fields that have been abandoned to forest and are also associated with Crossville stony loam.

The upland-hardwoods type is extensive and coincides roughly with soil association 4. Soils underlain by limestone support a deciduous forest of highly desirable composition, including the better oaks, hickory, black walnut, yellow-poplar, and occasionally redcedar.

The most extensive type, blackjack oak-hardwoods, is on soil associations 1 and 2. In most places the stand is open, as the merchantable timber has been removed, leaving the culls mixed with a scattered reproduction that has been deformed and stunted by fire and grazing. Post, blackjack, scarlet, and white oaks, and occasionally other oaks, hickory, blackgum, pine, sourwood, maple, and dogwood comprise the principal species. This forest type is found on soils of the Muskingum, Hartsells, Hector, and Crossville series. Areas almost entirely of black tupelo or sweetgum and red maple, of value primarily for pulpwood, occur on poorly drained bottom lands and in narrow almost level strips along the intermittent drainageways in direct association with soils of the Atkins, Lickdale, and Philo series.

In 1909 there were 44 (*5*) active sawmills in the county, whereas in 1912 there were 14 (*14*), one of which cut more than a million board feet of lumber a year. The number of sawmills in 1940 was 30, with 3 shuttle block mills, 2 hickory handle mills, and 1 stave and heading mill.[9] In addition to saw timber, important forest products were cross ties, chestnut poles, spikes, handles, extract wood,

[9] Information from the Forestry Relations Department of the Tennessee Valley Authority.

and tanbark. Originally, chestnut supplied possibly 15 percent (*1*) of the timber.

The 1938 cut of lumber was 6,040 thousand board feet of pine and 695 thousand of hardwoods, with 192 thousand of hardwood cross ties and 1,435 standard cords of hardwood for handle, shuttle block, and stave mills. This drain in 1939 amounted to 10,205 thousand board feet of pine lumber, 1,010 thousand of hardwood lumber, 4,800 pieces of hardwood ties (192 thousand board feet), and 1,290 standard cords aside from quantities used for chestnut extract wood, fuel wood, fence posts, and mine timbers.

In 1941 the sawmills, together with three shuttle-block plants and three other wood-using plants, purchased timber [10] from the landowners in the amount of 16,456 thousand board feet of lumber, 640 thousand of hewn cross ties, 74 cords of mine timbers, 438 cords of wood for shuttle blocks, and 1,341 cords of wood for the three other wood-using plants. In addition to the local markets, 4,000 cords of dead chestnut for extract wood were sold to the extract plant in Harriman (Roane County), and 1,500 cords of hardwood pulpwood and a small quantity of pine pulpwood were shipped to points outside the county. The production of fuel wood was 24,350 cords and of fence posts, 1,375 cords.

The 1940 estimates of timber volume, timber drain, and timber growth, according to the 1942 State report, for Cumberland, Fentress, Morgan, and Scott Counties as a group indicate some forest depletion by increased cutting during World War II. The volume of saw timber was 138,000 thousand board feet, drain 90,000 thousand, growth 29,000 thousand, and balance at end of year 67,000 thousand. Serious depletion continues in saw timber sizes with an increase in cordwood sizes, much of which will be suitable only for fuel wood, chemical wood, and pulpwood, rather than being potential crop timber for production of lumber.

The capacity of the forest land in Cumberland County in 1943 was estimated to be 3,459 thousand board feet in saw timber trees [11] and 131,815 cords in cordwood size trees. These quantities represent the maximum yield of timber that could be had in 1943 without depleting the growing stock. Actually the saw timber is being cut at the rate of 2.3 times the above footage, whereas the cordwood growth amounts to 5.0 times that cut from trees of cordwood size. If the possibilities are to improve over the long term, it will be necessary when the emergency is over to reduce the volume of saw timber cut. In order to build up sustained productivity of the forests, it will be necessary to cut less than the growth each year. Although current production of saw timber is about 16 million board feet, conditions indicate that it will have to be reduced to about 3 million in order to build up the growing stock. If such a policy were followed for 50 to 75 years, it would be possible then to cut 50 million board feet of saw timber every year without depleting the supply. The potential sustained production of saw timber is more than 3 times that currently

[10] TENNESSEE STATE REPORT. WAR PRODUCTION GOALS AND THEIR ATTAINMENT: FORESTRY AND FOREST PRODUCTS. CL—9949, 23 pp., 1942. [Processed.] (Bur. Agr. Econ.)

[11] See footnote 10 above.

cut. The potential cordwood may be proportionally greater than that of saw timber, providing management practices improve.

Fire protection is basic to all forest management and is the most important forest problem in the county. The main cause of forest fires is burning to improve woodland grazing. Although an organized fire-protection system is essential, an educational program that emphasizes the value of research and local observation would be required to change prevailing sentiment and answer questions in the minds of range burners. Likely one of the most helpful measures would be to continue the development of permanent pastures and the building up of strains of more efficient livestock, as farmers with good cattle are reluctant to let them run loose in the woods.

The annual average fire record for the 3-year period 1941–43, inclusive, was 200 fires with 12,752 acres burned over. The average size of the burned-over areas was 64 acres. Three lookout towers, one located north of Crab Orchard, another at Lantana southwest of Crossville, and the other northwest of Creston, were erected in the county, all connected by telephone and supplied with semivolunteer crews of fire fighters. In addition, six towers, are so located as to overlook substantial areas of forest land in the county. All these towers provide the means for quick discovery of fires. Without quick and effective action to suppress fires, the advantage of prompt discovery is lost. To make such action possible, the current trend in organization is toward motorized crews of highly trained fire fighters for each tower or for some equally advantageous center.[12]

A decided change must be made to halt the progressive deterioration of the forest resources of the county. A much greater value must be placed on the potential crop tree, and in order to increase the quantity and quality of the future growth, an intensified effort must be made to utilize fire-damaged, crooked, and otherwise defective individuals left during past years of logging. A satisfactory stocking of small- and medium-sized trees that are sound and fast growing must occupy the ground. In order to rebuild inventory, a halt or slowing up in the sale of desirable thrifty smaller sized trees of good form is required where a nucleus exists for future merchantable timber. Cruising and marking timber trees in advance of selling will convince the owner of the merits of closer attention to the details of marketing. Clear cutting of timber and the clearing of the land for crops and pasture need to follow a carefully considered plan, rather than be applied to all timberland regardless of use suitability, based on topography, depth to bedrock, stoniness, and similar considerations.

Many areas have been so severely burned over or so thoroughly harvested of timber that no worth-while nucleus of small sound trees exists. An extension of pine might well be encouraged in many places. White pine appears to be well suited for planting such land, except on south and west exposures and on especially dry sites caused by the closeness of bedrock to the surface. White pine is growing on 31,437 acres, 16,766 of which have more than 50 trees each and 14,671 less than 50 each.

[12] From records through 1940 of the Forest Division of the State Department of Conservation.

Areas containing native ribes have been mapped, and planting sites in the infested areas and within 900 feet of currant and gooseberry bushes must be checked before planting white pine, which also must be protected from fire. Cattle, sheep, and goats nip off white pine seedlings set in woodland pastures. Shortleaf pine is recommended for planting on open land where erosion is evident and on areas where conditions of site are too severe for white pine.

Fire control is necessary not only to produce satisfactory forest but also to maintain maximum soil porosity and to control erosion. A protective layer of forest litter absorbs the impact of falling raindrops and preserves the tiny pores and channels between the soil particles through which the water makes its way inward. Fungi, bacteria, and tiny animals that consume the litter and each other thereby produce a dark-brown colloidal substance called humus, which when carried downward into the mineral soil by percolating water, improves both physical structure and soil fertility. The litter and humus are also able to absorb immediately water that falls on the land. Porosity is further achieved by channels made by decayed roots. The binding of the soil by surface roots is highly beneficial, the densest network of which is in the lower parts of well-developed layers of the litter.

Fire prevention is justified, if only for the preservation of forest litter and humus in land eventually to be cleared and used as farms. Fires burn up the wealth in the soil. A comparison of the soil profile in two areas of virgin pine, one burned for 42 years and the other unburned, showed the destruction of 121,280 pounds of organic matter an acre and the consequent loss of 1,126 pounds of nitrogen. Aside from causing the loss of nitrogen, fires rob the tiny nitrogen-fixing organisms of organic matter, thereby reducing their ability to build the supply of nitrogen. Actual tests show that soils rich in organic matter hold from five to seven times as much moisture as does pure sand (*18*).

An experiment (*3*) conducted for 1 year by the University of Georgia shows a loss of 112,316 pounds of soil an acre on an exposed subsoil or badly eroded plot, whereas in a wooded area the loss was only 115 pounds an acre, largely attributed to the disturbance of the plant-root system by the insertion of a galvanized iron band to enclose the area. Results obtained at an erosion station near Statesville, N. C., showed [13] a loss of only 0.0021 of a ton of soil and 0.1220 percent of the rainfall from a plot of virgin woods. A companion woods plot, burned twice yearly, had progressively larger increases both in erosion and percentage of runoff. Both erosion control and maximum absorption, therefore, resulted from complete forest cover, as soil forested with an old growth (*2*) is more porous and absorbs water much more rapidly than that in cultivated fields. Where the forest cover is properly maintained, soil covered with a second growth does not lose its porosity unless it is overgrazed or the litter is destroyed by fire.

[13] BARTEL, F. O., and SLATER, C. S. PROGRESS REPORT OF THE CENTRAL PIEDMONT SOIL AND WATER CONSERVATION EXPERIMENT STATION, STATESVILLE, N. C., 1930–35. U. S. Soil Conserv. Serv. SCS–ERS–6, 134 pp., illus. 1938. [Processed.]

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 the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material. The climate, and its influence on soil and plants, depends not only on temperature, rainfall, and humidity but also on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

This section on the morphology and genesis of soils presents the factors of soil formation that have brought about the similarities and differences among the soils of the county, the natural classification of the soils, and the characteristics of the soil series.

FACTORS OF SOIL FORMATION

Climate and vegetation change the parent material from an inert heterogeneous mass to a body having more or less definite genetic morphology. Their action on the parent material is aided or hindered to varying degrees by the relief, which determines to some extent runoff, movement of water through the soil, natural erosion, and natural vegetation. The character of the parent material itself also aids climate and vegetation in soil formation and is important in determining the conditions of temperature and moisture within the soil and, indirectly, the kinds of natural vegetation. Throughout the genesis of soils, time brings about changes; hence, age is a factor in the development of the soil into a body in equilibrium with its environment. The degree of soil development depends not only on time but also on the rate at which the forces of climate and vegetation act; these, in turn, being governed by relief and parent material.

PARENT MATERIAL

The parent material of the soils of this county consists of two classes according to the source of the material: (1) Residual material derived from the decomposition of rocks in place and (2) transported material or material removed from its original position and deposited on valley uplands and near streams. The first class consists of weathered products of the underlying rock; the second, of rock fragments and other rock waste and soil material moved by gravity and water from the uplands and deposited at the foot of slopes and alluvial material derived from the uplands and deposited near streams by running water. The material of the first class is related directly to the underlying rocks from which it came; that of the second class to the soil or rocks from which it was removed.

Sedimentary rocks consisting of sandstone, shale, and limestone have given rise to the parent material. These rocks differ somewhat in composition, as also do the parent materials derived from them. Probably 98 percent of the soil of the county was formed from materials weathered from sandstone and shale, principally sandstone.

It is probable that differences in most soils derived from the residua of rocks in place can be attributed to differences in the mineral composition of the rocks. In places, however, where the same kind of rock underlies different soils, the differences in the soils resulted from causes other than differences in rock composition. Although some of the soil characteristics can be correlated with the kinds of parent material, others, especially those of regional significance to soil genesis, have been produced by other factors, principally climate and vegetation.

CLIMATE

The climate of the county is characterized by long mild summers, short moderate winters, and abundant precipitation (mean annual, 54.19 inches). Because moderately warm weather prevails and the soil is moist most of the time, chemical reactions are relatively rapid. Rain has caused the leaching of soluble materials, as bases, from the soil and also the removal of less soluble materials and colloidal matter downward in the soil. The soil is frozen for only brief periods and to shallow depths, thereby intensifying the action of weathering and the translocation of insoluble materials within the soil. In general, the climatic conditions give rise to Red Podzolic and Yellow Podzolic soils.

VEGETATION

Higher plants, micro-organisms, earthworms, and other forms of life that exist on and in the soil contribute to its morphology. The nature of the changes caused by each depends, among other things, on its kind and its life processes. The kinds of plants and animals are determined by the climate and by many other factors of the environment. Although climate is the most apparent of these, it is not the only important factor that determines the kinds of plants that grow on the well-developed, well-drained soils. Through its influence on the kind and density of vegetation, climate influences indirectly and greatly the morphology of the soils. Climate and vegetation together, therefore, are the active factors of soil genesis.

A forest largely of deciduous trees originally covered the region in which this county is situated. Nearly all of that forest has been removed for timber, and the present forest is practically all second growth. Many of the trees are moderately deep feeders and shed their leaves annually. Although the content of plant nutrients in the leaves varies considerably, the quantity of bases and phosphorus returned to the soil is generally larger than that returned by the leaves of conifers. Through the decay of leaves, essential plant nutrients derived from the soil are returned to its upper part.

Organic matter derived from decayed leaves, twigs, roots, and some entire plants accumulates in the upper part of the soil. It is acted on by micro-organisms, earthworms, and other forms of life, and chemical reactions directly result. Organic acids released by the decomposition of the organic matter promote the solution of slowly

soluble constituents and also the leaching and displacement of inorganic materials. The intensity of the results is conditioned by climate to the degree that it affects the kinds of plant and animal life present and the rates of the reactions and leaching.

RELIEF

The relief ranges from nearly level in first bottoms along streams to steep in the rougher uplands. On some steep slopes the runoff of rain water and the geologic erosion are so rapid as almost to keep pace with rock weathering and soil formation. As material for soil formation is thus removed, enough rarely remains in place a sufficient time for a profile of genetically related horizons to be formed. Only small quantities of water percolate through the soil, and leaching and the translocation of insoluble material downward in the soil are relatively inactive. The vegetation is generally more sparse than on soils having better moisture relations.

AGE

Soil material that has been in place only a short time is changed very little by climate and vegetation, and profiles having genetically related horizons have not developed. Most of the soils in first bottoms along streams are of this kind. Soil material on steep slopes is replaced through rock weathering as the soil mantle is removed by geologic erosion, and very little opportunity is present for the formation of the genetic profile. These two broad classes constitute the young and very young soils. Under favorable conditions of relief and the other factors of soil genesis, soil material in place for a long time develops into a soil that, when it has reached approximate equilibrium with its environment, is considered mature or old. The soils of this county range in age from very young to old, but over a very large part they are very young and young.

CLASSIFICATION OF SOILS

The natural classification of soils is based on their characteristics, so that they may be remembered through these characteristics and the problems regarding them may be better understood.

Soil types having layers, or horizons, that are similar in such characteristics as color, thickness, and arrangement but differ in texture and associated characteristics, as consistence, are grouped into series. Generally, differences in the texture of the soil types of a series are reflected in all the layers of the profile, but the types are defined in terms of the texture of the surface layer. Fewer and less specific statements can be made regarding the soil series as a whole than regarding any of its types, unless there be only one type.

Soil series may be grouped in higher categories, including the soil order, which embraces three major divisions, namely, zonal, intrazonal, and azonal.

A classification of the soil series of the county in higher categories, their parent material, relief, internal drainage, and age are given in table 15. This classification is incomplete, being subject to revision as knowledge about the series and their relations increases.

TABLE 15.—*The soil series of Cumberland County, Tenn., classified in higher categories, and some of the factors that have contributed to their morphology*

Great soil group	Series or land type	Parent material	Relief	Internal drainage	Age [1]
ZONAL SOILS					
Red Podzolic	Dewey	Residuum from the weathering of high-grade dolomitic limestone.	Undulating to rolling	Medium	Old.
	Talbott	Residuum from the weathering of argillaceous limestone.	Undulating to steep	Medium to slow	Do.
Yellow Podzolic	Hartsells	Residuum from the weathering of sandstone and some shale.	Gently undulating to rolling	Medium	Do.
	Crossville	do	do	do	Do.
	Jefferson	Colluvial and local alluvial materials derived from uplands underlain by sandstone and some shale.	Gently to strongly sloping	do	Old to young.
	Holston	General alluvium consisting of materials derived from uplands underlain by sandstone and some shale.	Level to gently sloping	do	Old.
INTRAZONAL SOILS					
Planosols	Johnsburg [2]	Residuum from the weathering of sandstone and some shale.	Level to nearly level	Slow	Old to very old.
	Wolftever	General alluvium derived mainly from uplands underlain by limestone.	Very gently to gently sloping	Medium to slow	Old.
AZONAL SOILS					
Alluvial soils	Emory [3]	Colluvial and local alluvial materials derived mainly from uplands underlain by high-grade limestone.	Level to gently sloping	Medium	Young to old.
	Lickdale [4]	Chiefly local alluvium derived from uplands underlain by sandstone and some shale.	Level to nearly level	Very slow	Young.
	Huntington	General alluvium derived mainly from uplands underlain by limestone.	do	Medium	Very young.
	Dunning [4]	do	do	Very slow	Young.
	Pope	General alluvium derived mainly from uplands underlain by sandstone and some shale.	do	Medium	Very young.
	Philo	do	do	Slow	Do.
	Atkins [5]	do	do	Very slow	Young.

Lithosols and miscellaneous land types.	Muskingum	Residuum from the weathering of sandstone and some shale.	Undulating to steep	Medium to rapid	Very young to young.
	Hector	do	Hilly to steep	do	Do.
	Rolling stony land:				
	Talbott soil material	Residuum from the weathering of argillaceous limestone.	Undulating to hilly	Medium to slow	Very young.
	Muskingum soil material	Residuum from the weathering of sandstone and some shale.	Rolling to hilly	Medium to rapid	Do.
	Rough stony land:				
	Talbott soil material	Residuum from the weathering of argillaceous limestone.	Hilly to steep	Medium to slow	Do.
	Muskingum soil material	Residuum from the weathering of sandstone and some shale.	Steep	Medium to rapid	Do.
	Smooth stony land (Muskingum soil material).	do	Level to gently rolling	do	Do.
	Limestone outcrop		Undulating to steep		

[1] Age refers to the degree to which the soil has developed properties that are characteristic of a mature soil. The terms used in describing age are relative. A very young soil has few if any of the characteristics of a mature soil; a young soil has these characteristics weakly to moderately well developed; an old soil has them well developed; and a very old oil has them developed to a greater degree than is common for the mature soils of the egion.

[2] The pan in the profile is not distinct and is at a greater depth than normal.

[3] In many places the profile has some characteristics of that of the Red Podzolic soil.

[4] Has some characteristics of Half Bog soils, in that the surface layer has a high content of organic matter and gleization has taken place to some extent in the subsoil.

[5] Some gleization has taken place.

ZONAL SOILS

Zonal soils belong to any one of the great groups of soils having well-developed characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms, chiefly vegetation (*16, p. 987*). The zonal soils in this county are members of the Red Podzolic and Yellow Podzolic great soil groups.

RED PODZOLIC SOILS

Red Podzolic soils comprise a zonal group of soils having thin organic and organic-mineral layers over a yellowish-brown leached layer which rests upon an illuvial red horizon; developed under a deciduous or mixed forest in a warm moist climate (*16*). The soil-forming processes involved in their development are laterization and podzolization (*16, 6*).

In this county soils that have common characteristics of the Red Podzolic soils are members of the Dewey and Talbott series. These soils apparently have formed under practically similar conditions of climate and similar vegetation. They are well drained and, although ranging somewhat in maturity, are old enough to have at least a moderately well developed Red Podzolic profile. The relief of the Dewey soils ranges from gently undulating to rolling and that of the Talbott from undulating to steep, but differences between the profiles probably are not caused primarily by differences in relief. Differences exist between the parent material of these soils, and many of the differences in the profiles may be attributed to the character and composition of the parent rock.

The soils of the Dewey series are associated with those of the Talbott and Emory series. They are the southern equivalent of Hagerstown soils but contain more red, are somewhat more leached of mineral plant nutrients, and apparently contain less organic matter.

The Dewey soils have formed from the residua of limestone containing more insoluble materials, especially silica, than the limestone giving rise to soils of the Talbott series, and they are generally deeper to bedrock and redder throughout the profile than those soils. The major differences between the soils of these two series seem to have been the direct and indirect result of differences between the parent material. The Dewey soils have moderately friable B horizons, whereas the Talbott have dominantly heavy-textured and tough B horizons.

Where the relief is smooth, the solum of the Dewey soils may be 6 to 8 feet thick, but where it is strong, the solum is not so thick. In general, the chert content of the soils is less in the areas of smooth relief than in areas of strong relief.

A description of a profile of Dewey silt loam in forest is as follows:

A_1. 0 to 3 inches, brown friable silt loam of fine crumb structure and moderately high organic-matter content; the layer is thickly matted with small roots.

A_2. 3 to 12 inches, dark grayish-brown friable silt loam with fine crumb structure containing a few chert fragments and a moderate quantity of decayed vegetation; small roots are numerous.

B_1. 12 to 20 inches, light reddish-brown silty clay loam with fine crumb structure containing fine chert fragments and small dark-brown concretions; when moist the material may be crushed to a smooth mass, but when wet it is somewhat sticky.

B_2. 20 to 44 inches, brownish-red to red heavy-textured silty clay loam with subangular nuciform structure containing many small dark-brown concretions and some fine chert fragments; the aggregates are coated with a glossy-red and yellow material and crush to a yellowish-red fine crumbly mass.

B_3. 44 to 60 inches, red or yellowish-red silty clay of firm but friable consistence, sticky when wet, and hard and brittle when dry; the facets of the structure particles are coated with a deep-red material; many small dark-brown concretions and some small chert fragments are present.

C. 60 to 80 inches, heavy-textured red clay or silty clay, mottled gray, yellow, brown, ocher, and olive; the material has fairly distinct subangular nuciform structure, is very sticky and plastic when wet, and contains many small weathered chert fragments.

Soils of the Talbott series differ from the Dewey in having a tough plastic reddish-yellow to reddish-brown B horizon, a thinner solum, and less depth to bedrock. They have formed from the residuum of weathered limestone containing argillaceous matter and are characterized by heavy-textured B and C horizons, characteristic of soils derived from residuum of argillaceous limestone. Their fairly low position on the landscape and shallowness to bedrock indicate that the parent limestone weathered rapidly and left a relatively small quantity of insoluble material. The soils are readily eroded when cultivated and may have eroded fairly rapidly when under natural vegetation, which possibly partly explains their shallowness to bedrock. The solum, however, varies considerably in thickness from place to place. Locally, bedrock is near the surface layer. Erosion is more active than on Dewey soils. In some places there are enough outcrops of bedrock to make the land stony.

Following is a profile description of Talbott silt loam under virgin conditions:

A_1. 0 to 2 inches, grayish-brown friable silt loam of low to medium organic-matter content.

A_2. 2 to 8 inches, yellowish-brown silt loam, moderately friable when moist but somewhat sticky and plastic when wet. It contains a relatively small quantity of organic matter.

B_2. 8 to 26 inches, compact tough yellowish-red silty clay, sticky and plastic when wet and hard when dry. It has angular nuciform structure, the surface of the particles being coated red, yellow, brown, and olive. Small firm black concretions and small angular chert fragments are in this layer.

B_3. 26 to 36 inches, yellowish-red, mottled with shades of red, yellow, and brown, heavy-textured silty clay of angular nuciform structure. It is less compact in place than the B_2 layer, and the aggregates crush more easily, forming a coarse crumb mass.

C. 36 to 60 inches, bright-red, profusely mottled with yellow, gray, olive, and shades of brown plastic heavy-textured clay, breaking into coarse irregular-shaped nuciform aggregates when disrupted. Some angular chert fragments are in the material. Underlying this layer is slightly argillaceous limestone containing a small proportion of chert.

YELLOW PODZOLIC SOILS

Yellow Podzolic soils are a zonal group of soils having thin organic and organic-mineral layers over a grayish-yellow leached layer which rests on a yellow horizon (*16*). The soil-development processes are podozolization with some laterization (*16*, *6*).

In this county the Yellow Podzolic soils consist of the Hartsells, Crossville, Jefferson, and Holston series. These soils occupy nearly level and gently undulating to rolling and strongly sloping relief. The vegetation under which they developed consisted largely of deciduous trees, but the cover may have been less dense than that under which the Red Podzolic soils developed. Climatic conditions for the development of the soils of each group were doubtless almost similar. The parent material of the Yellow Podzolic soils, however, contained much siliceous matter. The causes of the development of these soils are not known, but in this county such soils are generally derived from parent material that is lower in bases than the parent material of the Red Podzolic soils, and drainage is slower in the lower part of the profile. It is probable that the character of the parent material largely brought about the formation of these yellow soils.

The soils of the Hartsells series have developed from the residuum of weathered horizontally bedded sandstone containing thin lenses of shale. They formed under a forest vegetation and under a slightly cooler climate than that under which soils in the Valley and Ridge province developed (*4*). The textural profile of the soils is not highly developed, but the soils are sufficiently mature to be considered zonal. As these soils are mapped, the degree of textural profile development varies somewhat from place to place and incipient siltpans are in the lower B or C layer of some of the local areas with very mild slopes.

The parent material is low in bases, a condition that may have contributed directly to the development of Yellow Podzolic soils as well as indirectly through its influence on the kind of vegetation that grew. The predominant trees were oak, and oak leaves are lower in bases and higher in lignin than are leaves of most of the other deciduous trees. The soils are strongly to very strongly acid.

A description of a profile of Hartsells fine sandy loam under virgin conditions is as follows:

A_1. 0 to 1 inch, medium-gray very friable fine sandy loam containing a small quantity of decayed vegetable matter.
A_2. 1 to 7 inches, grayish-yellow very friable fine sandy loam.
B. 7 to 20 inches, pale-yellow friable fine sandy clay without definite structure; this material readily crumbles to a soft mass.
C. 20 to 35 inches, yellow, splotched with bright yellow, red, and rust brown, friable fine sandy loam containing numerous sandstone fragments. Horizontally bedded sandstone bedrock underlies this layer. About 4 inches of material immediately above the bedrock is lighter in texture than the rest of the layer.

The soils of the Crossville series were developed under vegetation and climate similar to those of the Hartsells soils. They differ from those soils in being browner throughout the profile and slightly thinner over bedrock, but the parent material is similar, consisting of level-bedded noncalcareous sandstone with some interbedded shale. Drainage may be slightly less rapid than in the Hartsells soils.

The following profile description is representative of Crossville loam under virgin conditions:

A_1. 0 to 2 inches, dark grayish-brown friable loam having moderate organic-matter content.
A_2. 2 to 7 inches, brown to grayish-brown mellow loam.
B. 7 to 20 inches, yellowish-brown friable fine sandy clay.
C_1. 20 to 27 inches, grayish-brown to yellowish-brown fine sandy clay, splotched with brown and red; the splotches are partly caused by numerous weathered sandstone fragments.
C_2. 27 to 30 inches, yellow fine sand mixed with partly weathered sandstone fragments; the bedrock of sandstone in horizontal strata underlies this layer.

Soils of the Jefferson series have developed on foot slopes of mountains from colluvium and local alluvium. The colluvium consists of fragments and other waste derived mainly from sandstone. These soils have yellowish-gray A horizons and yellow B horizons. The character of the profile may be attributed largely to that of the parent material.

In forests the surface layer of Jefferson fine sandy loam to a depth of about 2 inches is gray, very friable, and of rather low organic-matter content, passing into a 12-inch grayish-yellow very friable layer containing very little organic matter. This is underlain by a layer of light-yellow friable fine sandy clay about 22 inches thick, below which is mottled yellow, gray, red, and brown friable fine sandy loam.

The Holston soil has developed from old alluvium consisting of materials derived from uplands underlain by sandstone and shale. It has gently sloping relief, good external drainage, and adequate but slightly restricted internal drainage. In this county it appears to be the oldest soil, with respect to degree of maturity, in the Yellow Podzolic group, and in some places its morphology approaches that of the Planosols.

Like the other Yellow Podzolic soils, the Holston soil has developed from materials that are low in bases, a condition that promotes the development of an eluviated surface layer. Slightly restricted internal drainage may have contributed to their yellow color.

A profile description of Holston fine sandy loam under virgin conditions is as follows:

A_1. 0 to 1 inch, grayish-brown loose open fine sandy loam, the dark color apparently being due to organic matter.
A_2. 1 to 8 inches, gray to yellowish-gray open light-textured fine sandy loam, relatively low in content of organic matter.
A_3. 8 to 14 inches, light-yellow somewhat firm but friable loam or fine sandy loam, which may be easily crushed to a loose yellow mass.
B_2. 14 to 30 inches, brownish-yellow clay loam, somewhat firm in place. It is moderately brittle, breaking into subangular nuciform aggregates easily crushed to a smooth friable mass when moist but rather hard when dry.
C. 30 to 45 inches, brownish-yellow, mottled with gray, yellow, red, and brown, fine sandy clay of no definite structure, and consisting of a loose friable mass when disrupted. In the lower part is a layer of sand, silt, and gravel.

INTRAZONAL SOILS

Intrazonal soils are any of the great groups of soils with more or less well-developed soil characteristics that reflect the dominating influence of some local factor of relief, parent material, or age over the normal effect of the climate and vegetation (*16*). In this county they are members of the Planosols great soil group.

PLANOSOLS

Planosols are an intrazonal group of soils with eluviated surface horizons underlain by B horizons more strongly illuviated, cemented, or compacted than associated normal soils, developed upon nearly flat upland surface under grass or forest vegetation in a humid or subhumid climate (*16*). In this county they are members of the Johnsburg and Wolftever series.

The soil of the Johnsburg series, occupying flat places and shallow depressions on uplands in association mainly with soils of the Hartsells, Crossville, and Lickdale series, has formed from residual material of weathered sandstone and shale and local alluvial and colluvial materials. Internal drainage is slow, and the lower part of the profile is waterlogged much of the time.

A profile description of Johnsburg very fine sandy loam under virgin conditions is as follows:

1. 0 to 5 inches, dark-gray mellow very fine sandy loam containing a medium quantity of decomposed vegetable matter.
2. 5 to 11 inches, grayish-yellow smooth friable very fine sandy loam.
3. 11 to 30 inches, pale-yellow friable very fine sandy clay.
4. 30 to 35 inches, yellow, mottled with gray and brown, somewhat compact very fine sandy clay.
5. 35 inches +, medium-gray somewhat compact very fine sandy clay material.

The Wolftever soil, occupying low terraces, was formed from alluvium washed mainly from uplands underlain by limestone. The relief is very gently sloping to gently sloping. External drainage is generally fair, and internal drainage is impeded by a compact layer in the subsoil but is generally adequate for most of the common crops. The compact layer of the profile is the B horizon, or illuviated layer.

Wolftever silt loam has a 7-inch light grayish-brown friable silt loam A horizon; a 12-inch yellowish-brown hard compact silty clay loam or silty clay B horizon, breaking easily into coarse angular particles; and a 20-inch yellowish-brown, somewhat mottled with gray and yellow, compact silty clay or silty clay C horizon underlain by mottled gray, yellow, and brown silty clay material or a layer of gravel.

AZONAL SOILS

Azonal soils are any group of soils without well-developed profile characteristics, owing to their youth or conditions of parent material or relief, that prevent the development of normal soil-profile characteristics (*16*). In this county they are members of the Alluvial soils and Lithosols great soil groups.

ALLUVIAL SOILS

The Alluvial soils are an azonal group of soils, developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes (*16*). In this county they include members of the Emory, Lickdale, Huntington, Dunning, Pope, Philo, and Atkins series. The Lickdale, Dunning, and Atkins soils have glei layers, apparently caused by the lack of drainage and aeration in the lower part of their profiles.

Except the Emory and Lickdale soils, which are derived from colluvial and local alluvial materials, the soils of this group are derived from first-bottom alluvium. They are young to very young, though in places the Emory soil may have characteristics of the Red Podzolic profile. The soils receive new alluvial material each time the streams overflow.

Differences among the series are apparently due to characteristics determined by the composition of the parent material and by the condition of drainage. Soils of the Lickdale, Dunning, and Atkins series somewhat resemble soils of the Half Bog great soil group, or soils that have developed largely through gleization. They, however, do not have highly organic surface layers, as do the Half Bog soils.

Soils of the Pope, Philo, and Atkins series comprise a catena as they have formed from similar parent material and their differences have been caused by the drainage conditions, the Pope soils being well drained, the Philo imperfectly drained, and the Atkins poorly drained.

The soil of the Emory series is associated with soils of the Dewey and Talbott series and has formed from material washed mainly from those soils and deposited at the foot of slopes, along intermittent drainageways, and in depressions. These colluvial deposits have been modified locally by alluvial deposits, but they have lain in place long enough for a fairly definite profile to have developed in many places. The soil has developed under a deciduous forest on level to gently sloping relief and is well drained. Its color is brown throughout, and the surface layer apparently contains a moderate quantity of organic matter.

The following profile description is representative of Emory silt loam:

1. 0 to 12 inches, rich-brown friable mellow heavy-textured silt loam having fine crumb structure; under virgin conditions the upper 2 or 3 inches has a darker color, caused by the presence of a larger quantity of decayed vegetation; in many places this horizon appears to be very recent accumulation of material washed from the adjacent upland slopes.
2. 12 to 30 inches, dark yellowish-brown heavy-textured friable mellow silt loam of fine granular structure; small dark-brown concretions are numerous in the lower part.
3. 30 to 48 inches +, brown, yellowish-brown, or reddish-brown moderately friable heavy-textured silt loam containing some small fragments of chert and many small dark-brown concretions.

The soil of the Lickdale series, derived from recent alluvium washed from the soils of the Hartsells, Crossville, and Muskingum series, occurs principally in long narrow strips along small drainageways. It is

poorly drained, owing to seepage of water from the adjacent uplands and to impaired percolation.

The surface layer of Lickdale silt loam to a depth of 3 to 10 inches is dark-gray or almost black mellow silt loam, underlain by a 10-inch grayish-yellow friable silt loam layer mottled with gray and brown. Below this is a medium-gray, mottled yellow, blue, and brown, friable silt loam layer about 12-inches thick, passing into grayish-blue friable silt loam.

The well-drained soil of the Huntington series has formed from alluvial material washed from uplands underlain mainly by limestone. It is associated in first bottoms near streams with the poorly drained soil of the Dunning series. In general, it is characterized by a brown profile, showing throughout very little differentiation in horizons.

The surface layer of Huntington silt loam to a depth of about 10 inches is dark-brown or brown friable silt loam. Beneath this is a brown or light-brown friable silt loam or silty clay loam layer about 26 inches thick, overlying mottled gray, yellow, and brown friable silt loam or silty clay loam.

The soil of the Dunning series was derived from heavy-textured alluvial material washed mainly from soils underlain by limestone. It is a young soil and is slightly alkaline to slightly acid throughout. The upper layer to a depth of 10 to 15 inches is stained dark by organic matter. The soil has some characteristics of Half Bog soils and has a glei horizon in the lower part.

Dunning silty clay loam has about a 10-inch dark-gray to almost black heavy-textured silty clay loam surface layer, apparently containing a medium quantity of decomposed vegetable matter. Below this is a medium-gray firm but somewhat plastic silty clay layer about 5 inches thick, underlain by a 15-inch mottled yellow, gray, and rust-brown tough plastic silty clay layer of small firm nuciform aggregates, passing into bluish-gray tough plastic silty clay of larger nuciform aggregates.

The soil of the Pope series occurs in first bottoms near streams, and the alluvium from which it was derived consists of materials washed from uplands underlain mainly by noncalcareous sandstone and shale and deposited near the streams by running water. It occupies level and nearly level relief and is subject to overflow from the adjacent streams. It is brownish in color to a depth of 40 to 50 inches and underlain by mottled soil material.

The surface layer of Pope fine sandy loam to a depth of about 10 inches is grayish-brown or yellowish-brown friable fine sandy loam, apparently containing a very small quantity of decomposed vegetable matter. It is underlain by a light-brown heavy-textured fine sandy loam or loamy fine sand layer about 35 inches thick, giving way to mottled gray, yellow, and brown friable soil material of the same texture.

The soil of the Philo series was derived from alluvium which originated on uplands underlain principally by noncalcareous sandstone and shale. It occurs on level and nearly level relief in first bottoms only a few feet above the adjacent streams and is subject to periodic flooding. Its profile is mottled at a depth of about 20 inches.

The upper layer of Philo very fine sandy loam to a depth of about 10 inches is grayish-brown or grayish-yellow friable very fine sandy loam,

underlain by a pale-yellow friable fine sandy clay layer about 10 inches thick, passing into a mottled gray, yellow, and brown friable fine sandy clay layer about 15 inches thick, containing a few rust-brown concretions. Below this is mottled gray, blue, yellow, and brown friable fine sandy clay soil material.

The soil of the Atkins series, occurring in association with Pope and Philo soils in first bottoms, has formed from alluvial material washed from uplands underlain generally by noncalcareous sandstone and shale. It is characterized by many mottlings and has developed some characteristics of a glei layer in the lower part of the profile. It occupies level and nearly level relief and is poorly drained, remaining wet most of the time.

Atkins very fine sandy loam has a dark-gray friable very fine sandy loam surface layer about 7 inches thick, apparently containing a medium quantity of decayed vegetation. This is underlain by a mottled yellow, gray, and rust-brown friable very fine sandy loam layer about 10 inches thick, passing into a profusely mottled gray, blue, and yellow friable very fine clay layer about 20 inches thick, below which is predominantly bluish-gray very fine sandy clay.

LITHOSOLS AND MISCELLANEOUS LAND TYPES

Lithosols are immature soils thinly developed over rock formations under conditions of ample to excessive moisture. The parent materials of the soils of this group vary widely in composition, being derived from a great number of igneous, sedimentary, and metamorphic rocks. The soils naturally vary widely in composition and productivity as a result of this variety of parent material and the differences in local conditions that govern the decomposition of rocks and the formation of soil. A comparatively small proportion of the land is cultivated (*16, pp. 1120, 1121*). These soils (skeletal soils) are an azonal group having no clearly expressed genetic soil morphology and consist of a freshly and imperfectly weathered mass of rock fragments. They are largely confined to steeply sloping land. In this county, they include members of the Muskingum and Hector series and a number of miscellaneous land types.

Soils of the Muskingum series are shallow and were derived from the residuum of weathered noncalcareous sandstone interbedded in some places with thin layers of shale. Little evidence of genetic morphology is apparent in most places. The steep relief favors geologic erosion, and the parent rock is resistant to weathering. In most places the soils have AC profiles, with a thin layer of forest litter (A_0) on the surface, a 1- or 2-inch A_1 horizon, or organic-mineral layer, and a 9- to 28-inch yellow to brownish-yellow fine sandy loam layer overlying unweathered sandstone.

A profile description of Muskingum fine sandy loam under virgin conditions is as follows:

$A_{0\ 0}$. 1½ to 2 inches of undecomposed leaf litter from deciduous hardwoods.
A_0. About ½ inch of very dark-gray or black well-decomposed organic matter.
A_1. 0 to 1½ inches, dark-gray loose fine sandy loam, stained dark by organic matter.
A_2. 1½ to 8 inches, light grayish-yellow loose fine sandy loam of low organic-matter content; small roots are numerous.

B_2. 8 to 16 inches, brownish-yellow friable fine sandy clay loam of weakly developed nuciform structure, easily crushed to a soft incoherent mass when disrupted; in many places this layer either is not very distinct or has not developed at all.

C. 16 to 28 inches, fragments of sandstone in a matrix of brownish-yellow, mottled with gray, red, and brown, friable fine sandy loam, devoid of structural development.

D. 28 inches +, bedrock of sandstone and some shale.

Mapped with this series are a few small areas of Yellow Podzolic soils similar to those of the Hartsells series.

The soils of the Hector series differ from those of the Muskingum in that they have reddish-brown to red instead of yellow thin mineral-soil layers over sandstone bedrock, but they occupy similar positions and are subjected to similar environmental factors. Their reddish color has apparently been inherited from the parent rock.

In forests the surface layer of Hector stony fine sandy loam to a depth of about 2 inches is dark gray, very friable, and contains a medium quantity of decayed vegetation. Below this is a grayish-yellow very friable layer about 7 inches thick, underlain by a yellowish red friable fine sandy clay layer about 10 inches thick, passing into a red layer of the same texture and about the same thickness. Beneath this is reddish-yellow friable fine sandy loam about 10 inches thick over sandstone bedrock. Many sandstones, up to 10 inches in diameter, are on and in the soil.

The miscellaneous land types are Rolling stony land (Talbott soil material), Rolling stony land (Muskingum soil material), Rough stony land (Talbott soil material), Rough stony land (Muskingum soil material), Smooth stony land (Muskingum soil material), and Limestone outcrop. They consist of outcrops of bedrock, loose rock fragments, or both, and some soil or earthy material. The relief is predominantly hilly and steep, though in a rather large aggregate area it is rolling. The many rocks and the steep slopes have restricted soil development. These land types are apparently true Lithosols.

LABORATORY DETERMINATIONS

The results of mechanical analyses of a sample of Hartsells silt loam, as determined in the laboratories of the Bureau of Plant Industry, Soils, and Agricultural Engineering, are shown in table 16.

TABLE 16.—*Mechanical analyses of a sample of Hartsells silt loam from Cumberland County, Tenn.*

Sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
403047	0–1	0.5	0.7	0.8	4.3	25.7	57.1	10.9
403048	1–8	.2	.4	.5	2.5	22.8	60.0	13.6
403049	8–30	.2	.2	.5	2.5	24.1	57.2	15.3
403050	30–36	.1	.1	.4	2.2	33.6	37.5	26.1

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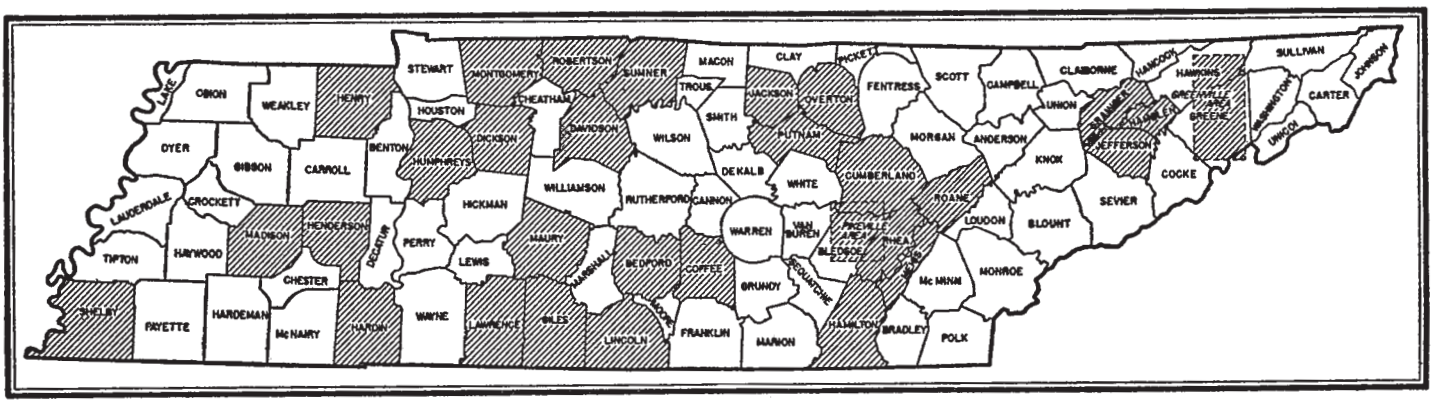

Areas surveyed in Tennessee shown by shading.

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To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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