

SOIL SURVEY

Claiborne County Tennessee

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TENNESSEE AGRICULTURAL EXPERIMENT STATION
and the
TENNESSEE VALLEY AUTHORITY

How to Use THE SOIL SURVEY REPORT

FARMERS who have lived in one locality for a long time come to know about the soil differences on their own farms and on those of their immediate neighbors. What they do not know, unless a soil survey has been made, is how nearly their soils are like those at experiment stations or in other localities from which higher yields are reported. They do not know whether these higher yields are from soils like their own or so different that they could not hope to get equally high returns, even if they adopted the practices followed in these other places. These similarities and differences are known only after a map of the soils has been made. Knowing what kind of soil one has and comparing it with soils on which new developments have proved successful will remove some of the risk in trying new methods and varieties.

SOILS OF A PARTICULAR FARM

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

Each kind of soil is marked with a symbol on the map; for example, all soils marked C_{no} are of the same kind. To find the name of the soil so marked, look at the legend printed near the margin of the map and find C_{no}. The color where C_{no} appears in the legend will be the same as where it appears on the map. The C_{no} means Claiborne silt loam, rolling phase. A section of this report (see table of contents) tells what this phase is like, for what it is mainly used, and some of the uses to which it is suited.

How productive is Claiborne silt loam, rolling phase? Find this soil name in the left-hand column of table 7, and note the yields of the different crops opposite it. This table also gives expectable yields for all the other soils mapped, so that the different soils can be compared.

Read in the section on Descriptions of Soil units to learn what are good uses and management practices for this soil. Look also at the section headed Use, Management, and Productivity of Claiborne County Soils, where the soils are grouped into land classes based on their physical use suitability and into management groups based on management requirements. What is said here on control of water, conservation of soil moisture, and other management practices may apply to Claiborne silt loam, rolling phase.

SOILS OF THE COUNTY AS A WHOLE

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

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

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

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

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SOIL SURVEY OF CLAIBORNE COUNTY, TENNESSEE

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¹ Claiborne County was originally included in the Norris area soil survey project, and the part included in that area was mapped under the direction of Foster Rudolph.

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AGRICULTURE has been the chief industry in Claiborne County since its settlement. Later, coal mining became important as its only large industry. The pioneer subsistence type of farming was first practiced because of the extensive tracts of poor land and the remoteness of the area from important centers of population. Production for home use is still the rule on more than half the farms, though local employment is found in several tomato canneries and small portable sawmills. The principal crops now produced are corn, wheat, lespedeza, clover, and burley tobacco, and small areas are in oats, barley, rye, sorgo, fruits, and vegetables. The kinds of livestock raised are chiefly beef and dairy cattle and poultry, with small numbers of hogs, sheep, and goats. To learn the best agricultural uses of the land a cooperative soil survey of the county was begun in 1939 by the United States Department of Agriculture, the Tennessee Agricultural Experiment Station, and the Tennessee Valley Authority. The essential findings in this survey may be summarized as follows.

SUMMARY

Claiborne County lies chiefly in the Great Valley of East Tennessee, the northwestern part on Cumberland Mountain. Drainage is to the southwest through tributaries of the Tennessee River. The valley section is divided into several minor physiographic divisions.

The typical mature upland soils have a grayish-brown friable silt loam surface layer and a red or yellowish-red clayey subsoil. These soils are generally low in fertility, acid, and low in organic matter. Because of local variations in parent material, slope, and other factors, however, the soils exhibit wide variations in color, texture, structure, consistence, depth, fertility, content of organic matter, moisture conditions, stoniness, and erosion. Based largely on these variations the soils have been classified and mapped in 39 soil types, 36 phases, 1 complex, and 11 miscellaneous land types.

The soils may be grouped in several ways for different purposes. On the basis of their position in the landscape they fall into four main categories—(1) soils of the uplands, (2) soils of the colluvial lands, (3) soils of the terraces, and (4) soils of the bottom lands. These groups are further divided on the basis of parent material and topography.

Upland soils derived from relatively high-grade limestone residuum include those of the Dewey, Talbott, and Colbert series. All have dominantly undulating and rolling relief, and the Dewey and Talbott soils have hilly and steep phases. On the uplands underlain by cherty and sandy dolomites, the soils developed are those of the Bolton, Claiborne, Fullerton, and Clarksville series. Except on rolling ridge tops, all these soils have dominantly hilly and steep relief. The Armuchee and Sequoia soils are derived from parent material weathered from interbedded limestone and shale, the Armuchee on steep knobs and the Sequoia on dominantly rolling relief, with shale and limestone bedrock at a depth of 3 feet or more in most places. The Montevallo, Lehew, Muskingum, and Hartsells soils are derived from acid sand-

stone and shale materials and have dominantly steep slopes. The Montevallo and Lehigh soils are on knobs and comby ridges, whereas the Muskingum are on the slopes of even-crested mountain ridges, and the Hartsells is on milder slopes and has a more distinct profile.

The soils of the colluvial lands derived from limestone and dolomitic materials include those of the Emory, Greendale, Ooltewah, and Guthrie series. The Emory soil is derived from materials washed largely from Bolton and Claiborne soils; the Greendale soils are on foot slopes and in the bottom of lime sinks underlain by local alluvium and colluvium from Clarksville and Fullerton soils; and the Ooltewah and Guthrie are chiefly in the bottoms of shallow lime sinks. The Caylor, Leadvale, Allen, and Jefferson are soils developed over old local alluvium and colluvium derived chiefly from sandstone and shale materials with some limestone influence. They are in low valley fans and foot slopes below ridges and mountains containing these materials. They are generally older and have more distinctly developed profiles than the soils developed from colluvial materials derived chiefly from limestone. The Caylor soils are on broad fans and benches in limestone valleys; the Leadvale are on slopes at the bases of ridges; the Allen is underlain chiefly by sandy materials from the Muskingum soils; and the Jefferson are underlain by sandy colluvium washed from the slopes of the adjoining mountains.

Soils of the terrace lands underlain chiefly by limestone materials include those of the Etowah, Taft, and Robertsville series. The Etowah soil is on gently sloping to sloping well-drained terraces; the Taft on nearly level imperfectly drained terraces; and the Robertsville on level or slightly depressed positions. On stream terraces underlain by materials derived chiefly from sandstone and shale, soils of the Waynesboro, Holston, Monongahela, Tyler, and Sequatchie series have developed. The Waynesboro soil is on old sloping high terraces; the Holston is less well drained; the Monongahela is on imperfectly drained terraces; the Tyler on level or slightly depressed positions; and the Sequatchie on low terraces.

The soils of the bottom lands, derived chiefly from limestone with some dolomite materials, are members of the Roane, Lindside, Melvin, and Dunning series. They are on first bottoms along small streams. The Roane is underlain by materials washed from cherty dolomite; the Lindside and Melvin are derived from mixed limestone and dolomitic materials; and the Dunning is underlain by clayey limestone materials. Pope, Philo, and Atkins are soils developed largely from sandstone and shale materials on the bottom lands. The Pope soil, washed chiefly from sandstone, is on the first bottoms; and the Philo and Atkins are derived from both sandstone and shale but are less well drained than the Pope.

About 20 percent of the soils of the county are classified as silt loams, 22 percent as cherty silt loams, 9 percent as cherty loams, 20 percent as stony fine sandy loams, 10 percent in all other textural classes, and 19 percent as miscellaneous land types. About half the county is uneroded or slightly eroded, but 2 percent has been reduced to a network of gullies, and the rest is sufficiently eroded to reduce productivity materially and to impair workability. About 58 percent

of the land has steep relief; 21 percent, hilly; 15 percent, sloping or rolling; and 6 percent is nearly level or undulating.

Nearly all the soils are acid. About 25 percent of them are free of stone, 56 percent are sufficiently stony or cherty to interfere with cultivation, and 19 percent are so stony that they are not suited to growing crops. When considered from the standpoint of use suitability, which is determined largely by the physical properties of the soils, 21 percent of the county is suited to crops, 25 percent chiefly to pasture, and 54 percent chiefly to forests. Taking the average of the Great Valley of East Tennessee as a standard, it is estimated that only about 3 percent of the soils suited to crops are high in productivity, whereas 37 percent are medium, and 60 percent are low.

The wide variation in physical and chemical properties affects the workability, productivity, and conservability of the soils in different parts of the county. To show the relative suitability of the soils for agricultural use, they have been rated on the basis of productivity and the ease with which they can be worked and conserved. Although each soil type or phase is given an individual rating, the soils may be placed in five numbered classes.

First-class soils, the best croplands of the county, are relatively high in productivity, easy to work, and easy to conserve.

Second-class soils, fair to good croplands, are generally lower in productivity and somewhat less easy to work and easy to conserve than First-class soils; unfavorable properties, however, have not been developed to an extent that would interfere materially with their use for growing crops.

Third-class soils, poor to fair croplands, are on the whole less productive than either First- or Second-class soils and are generally more difficult to work and conserve. Under good management, however, they are suited to growing crops.

Fourth-class soils have one or more unfavorable properties developed to such an extent that they are not generally suited to crops, but under good management are suited to pasture. They may be fairly productive but are at least moderately difficult to work or conserve.

Fifth-class soils have unfavorable properties, such as low inherent fertility, stoniness, erosion, and strong slopes to the extent that they are low to very low in productivity and difficult to work and conserve. They are not suited to crops or pasture and are limited to forest use.

To show differences in the way the soils should be managed, they may be arranged in 14 groups on the basis of similar management requirements. Groups 1 to 9 include the soils suited to crops; groups 10 to 13 those suited to pasture; and group 14 those suited to forestry.

Estimates of yields and productivity ratings show the relation among the soils of the county in terms of relative productivity for the important crops.

Water control on the land is concerned with runoff and drainage. Runoff control is the greater problem, but it can be accomplished through proper land use and management. Among the measures that can be employed are selection and rotation of crops; use of fertilizer, lime, and other soil amendments; contour furrowing; strip cropping; construction of terraces, check dams, and other engineering structures; planting trees or sod-forming crops on critical areas; and control of

grazing. The particular measure or combination of measures necessary to accomplish runoff control varies from field to field, from farm to farm, from one part of the county to another, and among the different soils. In some places the efforts of the individual farmer are needed, whereas in others cooperative action by the farmer, his community, and various State and Federal agencies will be required.

Drainage is much less a problem than control of runoff. Only about 3 percent of the county area is poorly and imperfectly drained. Local farm and economic conditions as well as engineering considerations and the properties of the soils themselves need to be considered in determining the feasibility of improving drainage by artificial means.

An interpretive map showing the extent and distribution of the First-, Second-, Third-, Fourth-, and Fifth-class soils or combinations of them is designed to show the general capability of broad areas of the county for use. Six associations of land classes are shown.

Forests are among the valuable natural resources of the county and cover about half its area. They are now greatly depleted, however, owing to overcutting and fire damage. In order to restore the forests to a higher level of productivity, increase their value as a source of raw material, and develop them as a means of flood control and as recreational centers, it is necessary (1) to control fires; (2) to prevent grazing by livestock; (3) to utilize defective and cull trees for farm purposes and in suitable industries; (4) to cut selectively, so that valuable trees are allowed to grow to maturity; and (5) to reforest steep, stony, and eroded lands that are unsuited physically to crops and pasture. Such a program of improvement will require cooperative efforts on the part of landowners and county, State, and Federal agencies.

A study of the morphology and genesis of the soils of Claiborne County shows five great soil groups represented—Red Podzolic soils, Yellow Podzolic soils, Planosols, Lithosols, and alluvial soils.

The Red Podzolic are mature soils formed on well-drained uplands, old stream terraces, and old colluvial lands. This group includes soils of the Dewey, Talbott, Bolton, Claiborne, and Fullerton series, all developed from parent material weathered from consolidated bedrock; Caylor and Allen soils, from old colluvium and local alluvium; and soils of the Etowah and Waynesboro series, from parent material from old stream alluvium.

The Yellow Podzolic also are mature soils but are developed from parent material lower in bases or of poorer internal drainage. This group includes the Clarksville, Hartsells, and Sequoia series, developed from consolidated bedrock in the uplands; the Holston and Sequatchie series, from old stream alluvium; and the Jefferson and Leadvale series, from old local alluvium originating from sandstone and shale accumulated at the foot of slopes.

The Planosols are imperfectly or poorly drained soils developed on nearly level or slightly depressed lands in the uplands or on old stream terraces and have hardpan layers at variable depths. In Claiborne County the Planosols are all on old stream terraces and include the Monongahela, Tyler, Taft, and Robertsville series.

The Lithosols have no definitely developed profiles, owing to strong slopes and the resistance of parent materials to weathering and soil-forming processes. They are thin and stony and are generally low in

lime, phosphorus, potassium, nitrogen, and humus. This group includes the Colbert, Armuchee, Montevallo, Lehew, and Muskingum series and also some of the miscellaneous land types.

The alluvial soils have little profile development, because of the recent time of deposition of the soil materials. They are on stream bottom lands, foot slopes of hills, and in the bottoms of lime sinks and depressions. The Roane, Lindside, Melvin, Dunning, Pope, Philo, and Atkins soils are derived from recent alluvium of the stream bottom lands; the Emory, Greendale, Ooltewah, and Guthrie from local alluvium and colluvium on foot slopes and in lime sinks.

GENERAL NATURE OF THE AREA

All of Claiborne County is in the southern section of the Appalachian Highlands, the northwestern one-fifth being on Cumberland Mountain and the rest in the Great Valley of East Tennessee. The mountain section has rugged relief with V-shaped steep-walled valleys and narrow even-crested mountain divides. The soils are underlain chiefly by massive sandstones and are shallow and stony. They are generally poorly suited to farming but do produce fair to good forests. Cutting and marketing timber and mining coal are the chief occupations of the people in this region. The Great Valley region consists of alternate parallel ridges and valleys underlain by dolomite, shale, and limestone. The soils are variable in properties, depending among other things on the kinds of parent material, slope, and stoniness, and they vary widely in use suitability. About 60 percent of this part of the county is cleared and used for farming. Corn, hay, tobacco, and wheat are the more important crops. Agriculture, of the subsistence type, is the chief means of livelihood of the people, but some employment is found in local business enterprises and intermittently in cutting and marketing forest products.

LOCATION AND EXTENT

Claiborne County occupies 277,963 acres in the northeastern part of Tennessee (fig. 1). Its northern boundary coincides with the Tennessee-Kentucky and the Tennessee-Virginia State lines. Cumberland Gap, in the north-central part, is immediately south of the junction of the Tennessee, Kentucky, and Virginia State lines. Tazewell, the county seat, is near the center of the county and is 40 miles northeast of Knoxville, 140 miles northeast of Chattanooga, and 180 miles northeast of Nashville. The county is roughly rectangular but

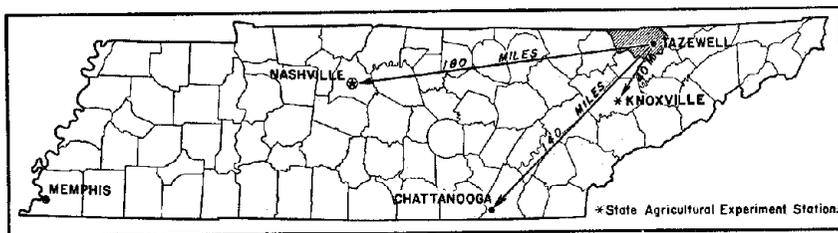


FIGURE 1.—Location of Claiborne County in Tennessee.

irregular in outline, and the Clinch River and the Norris Reservoir form the southern boundary.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Except for a triangular area on Cumberland Mountain in the northwestern part, all of the county is in the Great Valley of East Tennessee.

The Cumberland Mountain forms the southeastern margin of the Cumberland Plateau and is higher than the plateau on the northwest and the Great Valley on the southeast (2).² This mountain was formed by a gentle folding and deep dissection of massive conglomerate sandstones, which are more resistant to weathering than the horizontally bedded sandstone and shale that underlie the adjacent Cumberland Plateau on the west.

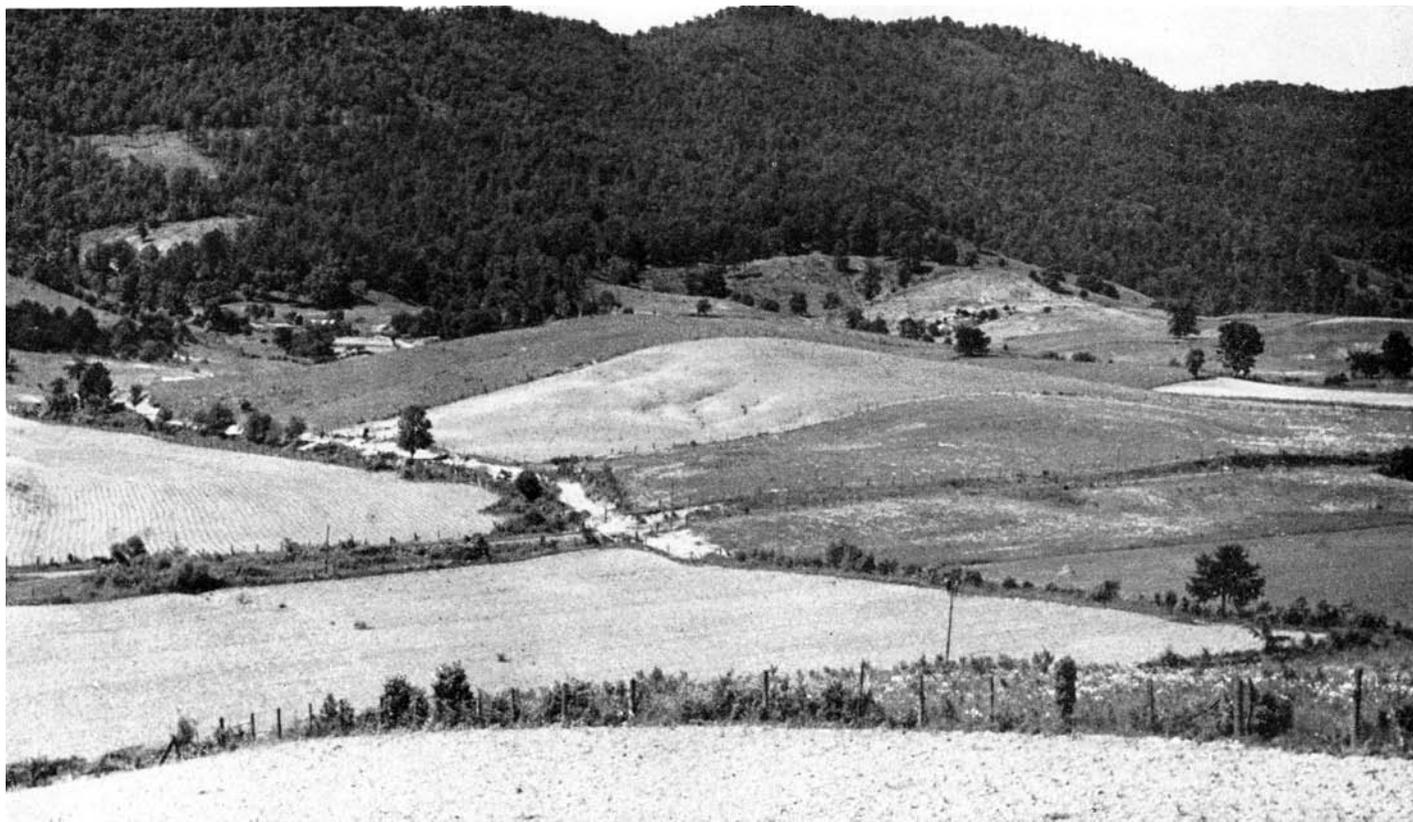
In Claiborne County, Cumberland Mountain consists of sharp, even-crested sandstone ridges alternated with narrow V-shaped valleys. The general elevation of the mountain crests is about 2,500 feet above sea level, although one peak on the north side of Valley Creek has an elevation of 3,100 feet. The valleys of the larger streams have an elevation of about 1,200 to 1,300 feet. In Claiborne County this mountain region drains to the northeast and the northwest into tributaries of the Cumberland River. The deep dissection of the area has exposed extensive coal deposits that are worked by means of drift mines. These mountains terminate in a steep rocky escarpment, which forms the northwestern rim of the Great Valley.

The Great Valley is a belt of lowlands lying between the Cumberland Plateau on the northwest and the Great Smoky Mountains on the southeast (2), (13), (14). It varies from place to place in both relief and elevation and contains many minor, roughly parallel ridges and valleys. Its greatest elevation in Tennessee is about 2,100 feet above sea level, near Bristol. From this point it slopes southwestward gradually to an elevation of 600 feet in the vicinity of Chattanooga. The underlying limestone and shale, which are less resistant to weathering than the rocks underlying the adjoining highlands, account for the existence of the valley. It is not a river valley.

That part of the Great Valley in Claiborne County has a wide range of relief and elevation (2). The limestone valleys are generally undulating to rolling and range in elevation from 1,200 to 1,300 feet, whereas the cherty ridges have hilly and steep relief and range from about 1,500 feet in the southwestern part of the county to 1,750 feet in the northeast. The shale and sandstone ridges are steep; and the crests of Powell Mountain, Lone Mountain, and Wallen Ridge are more than 2,000 feet high. The valley section of the county has, as a whole, a trellised drainage pattern, but some of the small streams in the cherty ridges in the central part have formed dendritic patterns locally. The valley part is drained by two tributaries of the Tennessee River—the Powell River, which flows through the central part of the county, and the Clinch River, which forms the southern boundary. All the small streams are tributaries of these two rivers.

The rocks underlying the Great Valley part of the county are limestone, dolomite, acid shale, calcareous shale, and sandstone (13), (14).

² Italic numbers in parentheses refer to Literature Cited, p. 245.



Powell Valley about 3 miles northeast of Speedwell. Fullerton soil is on the hilly ridge slopes in immediate foreground, Lindside soil on narrow bottom land just beyond, Allen and Caylor soils in center, Jefferson soils on the mountain foot slopes, and Muskingum soils and rough stony land on the steep wooded Cumberland escarpment in background.



Gorge of the Powell River in the Fullerton-Clarksville-Claiborne (hilly to steep) association. Cherty Clarksville and Fullerton soils are on the steep wooded slopes and narrow ridge tops; Pope and Sequatchie soils on the narrow bottom land and low terrace in right center; Sequatchie and Greendale soils in the small cleared area at the left of center.

Although less resistant to weathering than the rocks of the surrounding highland, these rocks do not weather at the same rate. They are also severely folded, and thrust faults and cross faults are common. This faulting and folding of the rocks, together with the differential weathering of the rock strata, has given rise to a series of parallel minor physiographic belts crossing the valley section in a northeast-southwest direction. With Cumberland Mountain which was previously discussed, these belts form 13 distinct physiographic divisions in the county. Starting in the northwestern corner and proceeding southeast these belts fall into the following sequence: (1) Cumberland Mountain, (2) Poor Valley Ridge, (3) Powell Valley, (4) a broad, deeply dissected plain underlain by Knox dolomite, (5) Cedar Fork Valley, (6) Wallen Ridge, (7) Little Ridge, (8) the valley of Little Sycamore Creek, (9) Powell and Lone Mountains, (10) the valley of Big Sycamore Creek, (11) Comby Ridge and Sycamore Knobs, (12)

Poor Valley Ridge forms a prominent feature in the northeastern Caney Valley and Caney Ridge, and (13) River Ridge.

part of Powell Valley. It is separated from the Cumberland escarpment by a narrow gorge. Its northern slope is underlain by sandstone of the Clinton (Rockwood) formation, but its southern slope is underlain by shales of the Juniata and Reedsville formations and limestone of the Trenton formation. Erosion of the limestone and shales has formed cone-shaped hills and sloping benches on the south face of the ridge. In the vicinity of Harrogate this ridge is about 1,800 feet high, but its crest dips to the southwest and the ridge disappears completely near Carr Gap.

Powell Valley is underlain chiefly by high-grade limestone of the Chickamauga group. Because these rocks weather rapidly and leave little residue, the general elevation of this valley, which is about 1,200 feet above sea level, is about 300 feet lower than the cherty ridges to the southeast and 1,200 feet lower than the Cumberland escarpment on the northwest. The valley is undulating to rolling in most places, although there are some scattered hilly areas (pl. 1). It is crossed by numerous small perennial and intermittent streams that have formed a trellised drainage pattern. The gradient of these streams is low, their courses comparatively straight, and their present flood plains narrow, but their valleys are rather wide. Stream terraces, together with colluvial deposits and local alluvium, form low fans and benches throughout the valley, and small lime sinks are in many places. This valley is about 20 miles long.

The dissected dolomitic plain is in the central part of the county and occupies more than half its area. This division is underlain by cherty and sandy dolomites of the Knox formation. The most conspicuous feature of this area is the deeply entrenched gorge of the Powell River. The river enters the county near the northeastern corner and follows a broadly meandering but generally westerly course to a point south of Cumberland Gap, where it turns and flows southwest, parallel to and about 5 miles southeast of the Cumberland escarpment. Small tributaries have deeply dissected an area 2 or 3 miles wide on either side of the river, causing steep and rugged relief (pl. 2). The rolling, round-topped ridges range from about 1,500 feet high in the southwestern part to about 1,750 feet in the northeastern, but most of the stream valleys are less than 1,200 feet. The flood plains and ter-

ances of both the river and its tributaries are narrow, seldom exceeding 300 feet in width, and have been flooded by the waters of Norris Reservoir southwestward from the point where Gap Creek enters the river.

Although the relief and topography described are characteristic of a large part of this division, an area in the central part extending from Tazewell southwestward has the karst topography characteristic of areas underlain by limestone. Lime sinks varying in size from small saucer-shaped depressions to large sinks with bottoms several acres in size are throughout the area. The land surface is very irregular, but local relief is less severe and slopes are not so steep as in the stream-dissected part.

Cedar Fork Valley, a narrow limestone valley ranging from $\frac{1}{2}$ to 1 mile wide, extends from Tazewell northeast to the county line. It is underlain by limestone of the Stone River, Black River, and Trenton formation (9, 13) and contains large areas of stony land. Small lime sinks are common along the north side, whereas alluvial fans and benches are along the south side. The land surface is irregular in form but slopes are not strong, and the valley generally has rolling topography. This division is drained by several small branches of the Powell River.

Wallen Ridge, from Tazewell northeastward, is underlain on the south slope by sandstone of the Clinton formation and on the north by calcareous shale of the Sequatchie, and Reedsville formations and by Trenton limestone (9, 13). These shaly rocks have formed characteristic cone-shaped knobs on the north slope of the ridge. The crest has an elevation of about 2,000 feet. Both slopes are steep and dissected by small intermittent drainageways; and streams have cut completely through the ridge, forming water gaps in several places. From Tazewell southwestward this ridge is underlain by Knox dolomite and is a continuation of the dissected dolomitic plain.

Little Ridge, with an elevation of about 1,800 feet, has steep slopes and a rolling rounded crest and is underlain by Knox dolomite (13). The slopes are dissected by numerous small intermittent branches of Little Sycamore Creek and other streams.

The valley of Little Sycamore Creek is another narrow limestone valley underlain by the Black and Stone Rivers and Trenton limestone (9, 13). This valley is somewhat narrower than Cedar Fork Valley. Lime sinks and alluvial and colluvial deposits are numerous throughout the valley (pl. 3, A). The general elevation is about 1,300 feet, and the topography is rolling. Drainage is through Little Sycamore Creek and several other small branches of the Clinch River. The valley extends from Springdale northeast to the county line.

Powell Mountain is the most conspicuous physiographic feature in the Great Valley part of the county. It rises abruptly, near Springdale, from the lower lying shale and limestone valleys to an elevation of 2,200 feet (13). Its north slope is underlain by Trenton limestone and Reedsville, Sequatchie, and Juniata shales; and it has cone-shaped knobs and sloping benches similar to those of Wallen Ridge and Poor Valley Ridge (pl. 3, B). The south slope is underlain by sandstone of the Clinch formation. Both slopes are steep and are dissected by intermittent streams but, because of the resistance of the sandstone to weathering, no water gaps are found and the crest of the ridge is comparatively even. Lone Mountain, in the south-central corner of

the county, is underlain by the same geologic formations and has similar relief and drainage.

The valley of Big Sycamore Creek is underlain chiefly by black shale of the Chattanooga formation in the northern end and by limestone and shale of the Conasauga group in the southern part (14). The general elevation of this valley is about 1,200 feet, but several small shale knobs and ridges may be as much as 200 feet above this level. Except for these hilly and steep ridges, the valley is nearly level and is composed chiefly of the flood plains and terraces of Big Sycamore Creek (pl. 4). The butt of Newman Ridge, which is underlain by massive limestone and shale of the Carboniferous age, is in the northern end of this valley. The ridge rises to an elevation of 2,200 feet and has steep and rugged topography. The southern end of the valley of Big Sycamore Creek is flooded by the Norris Reservoir.

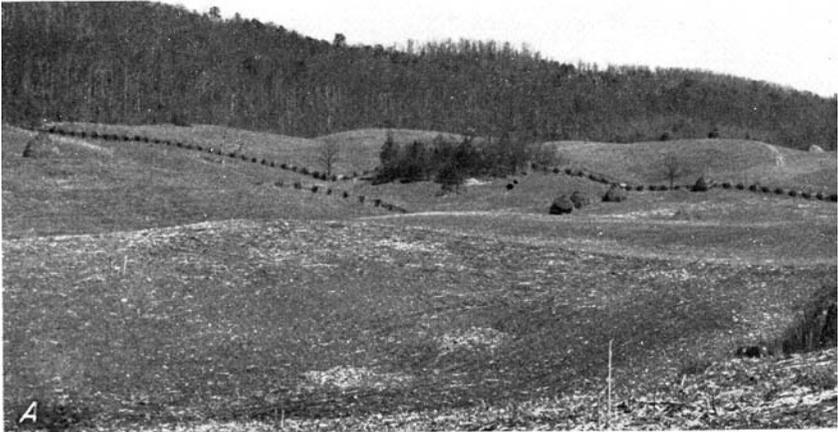
Comby Ridge and Sycamore Knobs are underlain by interbedded shale and sandstone of the Rome formation. The crests of these ridges have an elevation of about 1,500 feet and have steep to very steep slopes (pl. 5, A). Small intermittent streams have dissected the slopes and have caused the serrated topography of these ridges. Water gaps have cut through them in several places.

Caney Valley and Caney Ridge are underlain by shale and limestone of the Conasauga group (14). The valley is underlain by limestone but has been covered by colluvial and alluvial deposits from the surrounding higher shale ridges. This valley is narrow, has an elevation of about 1,200 feet, and is gently rolling in topography. The small streams have formed a trellised pattern and drain into the Clinch River. Caney Ridge is underlain by slightly calcareous shale and its crest has an elevation of about 1,500 feet. The ridge has been deeply dissected by small streams and there are many stream gaps. This dissection has formed steep knobs in the shape of truncated cones, and the ridge is made up of a series of these knobs.

River Ridge is another cherty ridge underlain by Knox dolomite (13). The crest of the ridge has an elevation of about 1,600 feet. The ridge is dissected by small lateral branches of the Clinch River and by the river itself, and hilly and steep topography prevail. The flood plains and terraces of the Clinch River, like those of the Powell River, are narrow and intermittent and are, for the most part, flooded by the Norris Reservoir.

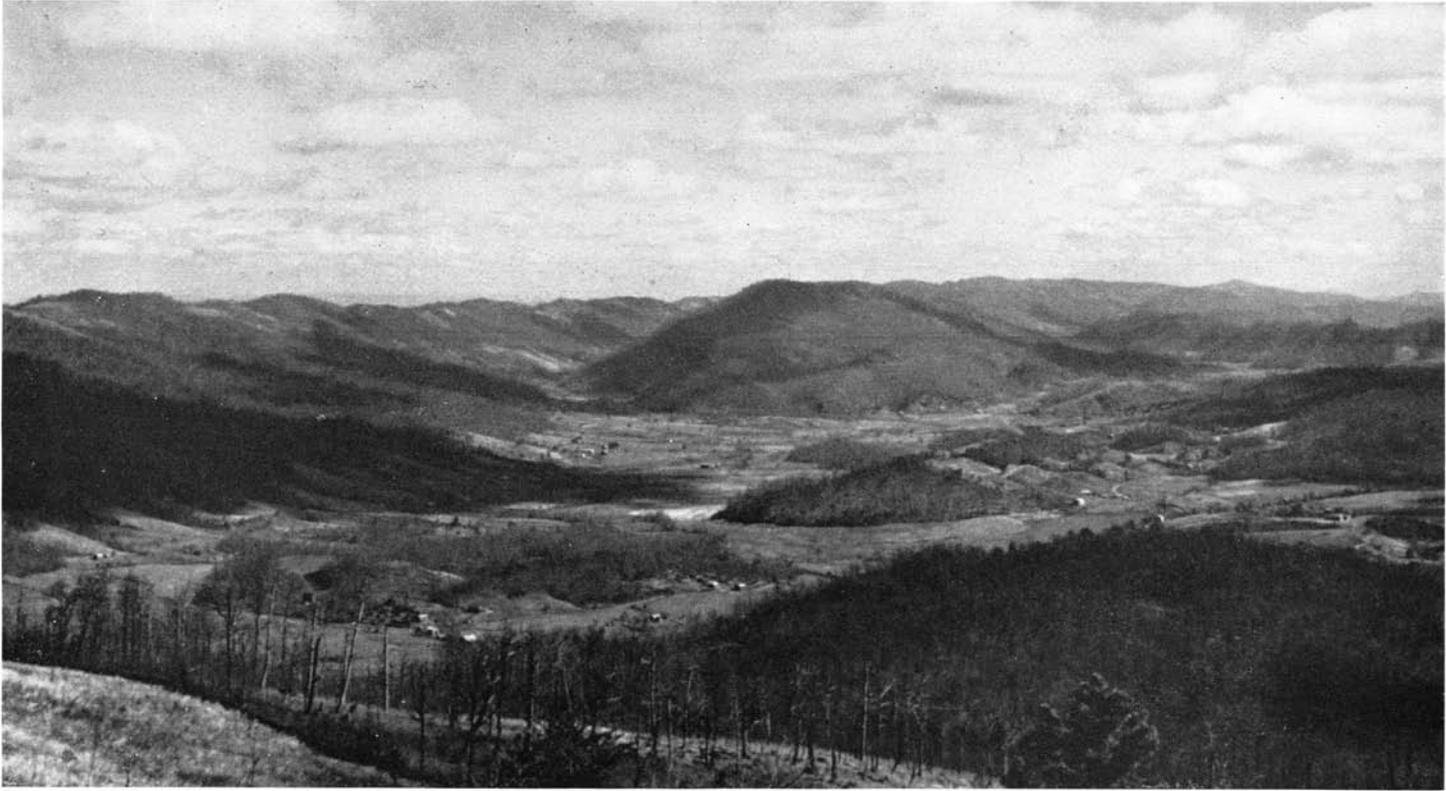
CLIMATE

The climate of Claiborne County is temperate and continental. The summers are long and warm and the winters short and open. The spread between the mean winter and mean summer temperatures is 36.7° F. Winters are normally not cold, the mean winter temperature being 36.3°. Sudden temperature changes, however, are frequent in winter. The ground is seldom covered with snow for more than a few days at a time, and the soil freezes to a depth of only a few inches, so that much of the plowing may be done during the winter months. The mean summer temperature is 73°, and hot sultry days are common. The average frost-free period of 174 days extends from April 25 to October 16. Killing frosts have been recorded as late as May 14 and as early as September 30, but normally crops are not injured



A, Valley of Little Sycamore Creek and Powell Mountain near the county line, looking north. Talbott and cherty Dewey soils are on the rolling upland slopes; Ooltewah and Greendale in the small lime sinks; Clarksville and Fullerton on wooded ridge in background. Irregular karst topography is characteristic of most limestone valley areas.

B, Skaggs Ridge (butt of Powell Mountain) seen from Comby Ridge. Muskingum soils are on the forested mountain slopes; Allen and Jefferson on the cleared fans and benches at the foot of the mountains.



Valley of Big Sycamore Creek, looking northeast from Skaggs Ridge. Muskingum soils are on the wooded slopes of Powell Mountain on the left; Jefferson soils on the cleared foot slopes; rough stony land in center on the butt of Newman Ridge; Lehew soils on the ridges in the right background; Monongahela, Philo, and Leadvale soils on the flood plains, low terraces, and colluvial lands in the cleared valley lands; Montevallo soils on the low wooded hills and knobs; Muskingum soils in immediate foreground.

by frost. The grazing period is from about the first of April to the middle of November.

The average annual precipitation is 50.21 inches. The rainfall is evenly distributed through winter, spring, and summer and is lowest in fall when many crops are being harvested. The highest average rainfall of 5.22 inches was in March and the least of 2.97 in October. Many times summer rains are torrential downpours accompanied by severe thunderstorms, but for the rest of the year rains are usually steady. Neither droughts nor periods of excessive rainfall are common, but crop yields, especially on droughty soils, are sometimes materially reduced by periods of light rainfall.

Slight variations in temperature and rainfall are probably due to local differences in elevation, exposure, and air drainage. These variations are not of sufficient magnitude to affect the general type of agriculture over the county as a whole. The rainfall is somewhat greater and the temperature slightly lower on Cumberland Mountain than in the rest of the county.

The normal monthly, seasonal, and annual temperature and precipitation, compiled from the records of the United States Weather Bureau station near New Tazewell, are given in table 1. These data are fairly representative of the Great Valley part of the county.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at New Tazewell, Claiborne County, Tenn.*

[Elevation, 1,250 feet]

Month	Mean temperature	Precipitation		
		Mean	Total for the driest year ¹	Total for the wettest year ²
	°F.	Inches	Inches	Inches
December.....	36.4	4.85	2.54	2.20
January.....	34.9	4.44	2.14	4.85
February.....	37.5	4.19	1.04	6.07
Winter.....	36.3	13.48	5.72	13.12
March.....	44.1	5.22	3.39	6.73
April.....	54.5	4.36	3.91	5.63
May.....	62.5	4.26	.50	3.73
Spring.....	53.7	13.84	7.80	16.09
June.....	71.5	4.38	4.16	5.81
July.....	74.3	4.32	9.05	8.20
August.....	73.2	4.96	3.12	10.96
Summer.....	73.0	13.66	16.33	24.97
September.....	68.0	3.23	.26	2.35
October.....	56.5	2.97	3.08	2.32
November.....	42.9	3.03	2.08	1.26
Fall.....	55.8	9.23	5.42	5.93
Year.....	54.7	50.21	35.27	60.11

¹ In 1941.

² In 1909.

WATER SUPPLY

Springs are numerous in the limestone valleys and along the perennial streams in the cherty ridges and furnish an adequate water supply for livestock and family use. Springs also provide the home water supply in the shale ridges and on Cumberland Mountain. The small perennial streams provide water for many of the permanent pastures throughout the county, and intermittent streams furnish water for this purpose during periods of heavy rainfall. In the higher cherty ridges, distant from flowing streams, cisterns are the chief source of water for family use, and livestock is dependent upon water collected in small ponds and reservoirs. Wells are rare in all parts of the county. Droughts of sufficient severity or duration to cause shortages of water for livestock or home use are uncommon.

The waters of the Norris Reservoir afford good fishing, boating, and swimming facilities that attract sportsmen from a wide area. Fern Lake on Cumberland Mountain also provides good fishing.

VEGETATION

Claiborne County, in the southern hardwood belt, was originally covered chiefly with deciduous forests. The commonest association of trees was chestnut, oak, and tuliptree (yellowpoplar) (10): There were, however, and still are, rather wide local variations in the kind of forest cover and the density of stand, caused by local variations in soil and moisture conditions. Although the entire county has been logged and the better classes of timber have been cut, 90 percent or more of the area on Cumberland Mountain and about 40 percent of the area in the Great Valley of East Tennessee are still in trees. The problems relative to the management, use, and conservation of the timber resources of the county are discussed in the section on Forests.

ORGANIZATION AND POPULATION

Prior to the arrival of the white man, the area now included in Claiborne County was an uninhabited wilderness used as a hunting ground by the Cherokee Indians. The first white settlement was made in Powell Valley, near Cumberland Gap, in 1783 (3), (5). In 1794 a settlement was made near Springdale by settlers from North Carolina, South Carolina, and Virginia. The Old Springdale Church was erected in the valley of Little Sycamore Creek in 1796 by the Baptist settlers of that area. The act authorizing the organization of the county was passed on October 29, 1801, and the first session of the county court was held in December of the same year. The county was formed from parts of Hawkins and Grainger Counties. Tazewell, the present county seat, was settled in 1801 (11). Annexations from surrounding counties have increased the area to its present size. Cumberland Gap, in the northern part of the county, was of considerable strategic importance during the Civil War, and several minor battles were fought there.

In 1810 the population of the county was 4,798. By 1830 it had nearly doubled (8,470), but there was little change from 1830 until 1870. The discovery and exploitation of coal fields on Cumberland

Mountain led to the construction of the Knoxville-Middlesboro branch of the Southern Railway in 1889. Cheap and easy transportation stimulated the lumbering industry, and land thus cleared attracted more settlers, so that by 1900 the population was 20,696. Since 1910 there has been no significant change. In 1940 the population was 24,657, all rural. The people are chiefly native-born whites of English, Scotch, and Irish descent. About 2 percent are Negroes.

The average density of population in the county is about 55 to the square mile, but it is not evenly distributed. Except for the coal mining villages Cumberland Mountain is very thinly settled. Most of the farms in this area are on the bottom lands of the larger streams. The ridges bordering the Powell River, River Ridge, Powell Mountain, Lone Mountain, Comby Ridge, and Caney Ridge also are sparsely settled. The thin population is a direct reflection of the unfavorable soil and land conditions that prevail. The best lands, however, are not the most thickly populated. The most desirable lands are in Powell Valley, Cedar Fork Valley, and the valley of Little Sycamore Creek, and the farms there are relatively large. The greatest density of population is probably in the rolling and hilly cherty ridges of the central part. Here, lands are of only fair to moderate fertility, and a large number of small subsistence farms are maintained.

Tazewell, with a population³ of about 800, is the county seat. New Tazewell (population 1,180) serves as a shipping point and market for the central part of the county. Other towns of importance with their population are as follows: Lone Mountain (175) in the southern part and Cumberland Gap (409) in the northern part, both important shipping points; Pruden (600), Clairfield (2,000), Eagan (1,000), Valley Creek (300), and Fork Ridge (450) on Cumberland Mountain, the more important mining towns and coal shipping points. Several other small trading centers are scattered over the county. All the larger villages are in the fertile limestone valleys and have developed as the result of the need of these more prosperous agricultural communities for trading and shipping centers.

INDUSTRIES

With the exception of coal mining there are no large industries in Claiborne County, but several small enterprises for marketing or processing agricultural products are operated. Five tobacco warehouses in New Tazewell furnish employment to local men during the auction season. Several small tomato canneries give employment for a few weeks each year. Small portable sawmills operate in various parts of the county and furnish employment to farm laborers and work stock in winter. One large logging operation along Tackett Creek gives several men year-round (1939) employment. Coal mining, the only nonagricultural industry, is carried on in the northwestern part of the county on Cumberland Mountain. In 1937 more than 1,000,000 tons of coal with an estimated value of about \$1,700,000 was mined, and employment was furnished about 900 men.

³ Population data from the 1942 Rand McNally Commercial Atlas and Marketing Guide.

ROADS AND RAILROADS

The county has adequate transportation facilities. A branch of the Southern Railway crosses the central part in a north-south direction, and another branch of this railroad and a branch of the Louisville & Nashville Railroad serve the Cumberland Mountain area. Federal Highway No. 25 E, a hard-surfaced road, traverses the central part of the county in a north-south direction, and State Highway No. 33 extends southwest from Tazewell. State Highways Nos. 63 and 33 follow Powell Valley and Big Sycamore Valley, respectively, and State Highway No. 90 crosses the northwestern corner of the county. A recent program of rural road improvement has provided graded and graveled roads for most parts of the valley section, but the ridges along the Powell River and parts of Caney Ridge in the southern part have no improved roads and are inaccessible to automobiles. Rural roads on Cumberland Mountain are few and poorly maintained and are impassable in periods of heavy rainfall. Foot or pack trails provide the only easy means of access to a large part of the mountainous area. No direct highway connects the valley and mountain sections of the county. In general the kinds of roads and the condition in which they are kept is a direct reflection of soil and land conditions.

SCHOOLS, CHURCHES, AND FARM IMPROVEMENTS

School and church facilities are adequate for the needs of the county. Elementary schools are in nearly all parts, and high schools are maintained at Pruden, Tazewell, and Powell Valley. Lincoln Memorial University, a 4-year coeducational liberal arts college, is at Harrogate. All villages have churches, and small country churches serve all parts of the county.

Although few farm homes are equipped with modern conveniences, the type and condition of the farm home and other farm structures are generally an expression of soil productivity and land conditions. The farm homes in the limestone valleys are commonly large well-kept brick or frame buildings. In areas of more productive soils in the cherty ridges neat frame houses are common; but in the steep cherty ridges, in the shale ridges, and on Cumberland Mountain, the farm homes are generally small and resemble the pioneer type of dwelling. In 1940 only 197 farm homes had electric lights and 91 had telephones.

General farm improvements, equipment, and farm machinery vary, as do the buildings, according to the productivity of the land. The best equipped farms are in the limestone valleys, whereas the poorest are on Cumberland Mountain. Heavy tractor-driven machinery is not generally used, but the better farms are adequately equipped with horse-drawn implements. Many farm operations are performed by hand on the poorer farms. In 1940 less than 1 percent of the farms had tractors and only 9 percent had farm trucks. Passenger automobiles are on 20 percent of the farms.

AGRICULTURE

The early agriculture of Claiborne County consisted largely of the production of subsistence crops for the use of the farm family and livestock. Because it was easily grown and provided food for both man and livestock, corn was the principal crop. Small crops of flax and cotton were grown for domestic use, and horses, cattle, sheep, and hogs were raised for home needs. Sugar was made from maple sap. Clothing, shoes, and furniture were made at home. The diet of the pioneer family included salt pork, potatoes, beans, corn bread, milk, and butter, supplemented with wild fruits and honey.

The agricultural development of the county was slow because of the remoteness of the area from urban markets, lack of transportation facilities, and the presence of large areas of relatively unproductive land. By 1873, however, the production of wheat and oats had become important (5). Timothy was extensively grown and clover was produced on a few farms. Many farmers fed the corn crop to livestock, and livestock production was the most profitable farm enterprise. Mules and horses were raised for home use and a few for export. The hillside plow had begun to replace the bull-tongue plow, and mowing machines, hay rakes, and cultivators were becoming common in Powell Valley. In 1873 more than 75 percent of the county was still in forest. Roads were few and very poor. Money was scarce and most trade was carried on by barter. Country storekeepers kept a supply of calico, spun cotton, sugar, salt, and coffee, which they exchanged for beeswax, dried fruits, ginseng, feathers, eggs, butter, chickens, maple sugar, bacon, corn, wheat, potatoes, onions, beans, peas, hides, and domestic manufactures. These products were shipped by flatboat on the Powell and Clinch Rivers to Knoxville and Chattanooga.

Until 1890 these river boats provided the only means of transportation of heavy freight to and from the county, and inasmuch as the rivers were navigable only during seasons of high water, the contacts with the outside world were meager. Consequently, the growth of the area was slow. The discovery and exploitation of the coal fields in the northwestern part of the county, however, and the consequent construction of the Knoxville to Middlesboro branch of the Southern Railway in 1889 led to more rapid growth. Markets for farm products and timber were much more accessible, and between 1880 and 1910 there were large increases in both the population and the number of farms. Since 1910 there has been no significant change in the population or the number of farms.

CROPS

Although the production of subsistence crops was and still is the chief agricultural enterprise in Claiborne County, there have been changes in the kinds and acreage. These changes are shown in table 2, which gives the acreage of the principal crops and number of fruit trees for the years 1879 to 1939.

The value of agricultural products by classes for certain years is given in table 3.

TABLE 2.—*Acres of the principal crops and number of fruit trees in Claiborne County, Tenn., for stated years, 1879-1939*

Crop	1879	1889	1899	1909	1919	1929	1939
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Corn	28, 475	29, 729	33, 449	31, 643	31, 263	23, 123	20, 541
Wheat	9, 128	6, 858	9, 706	7, 790	8, 346	2, 590	5, 125
Oats	9, 136	12, 379	7, 662	2, 706	3, 075	219	338
Barley			1		4	14	369
Rye	484	22	34		33	37	69
All hay	1, 613	2, 924	5, 267	7, 993	12, 331	13, 145	18, 321
Lespedeza hay							9, 758
Timothy and clover				4, 400	4, 321	9, 227	5, 166
Clover alone			1, 004		1, 093	239	
Timothy alone				3, 129	3, 013		
Other tame grasses			3, 969		1, 946	2, 642	2, 430
Alfalfa					25	22	198
Sweetclover							90
Grains cut green			276	435	157	195	344
Wild grasses			18	29	511	131	169
Legumes cut for hay					1, 265	689	166
Silage and coarse forage			89	94	11, 013	228	31
Tobacco	43	11	111	15	24	1, 632	2, 501
Sorghums		274	322	427	825	86	141
Potatoes		332	498	979	593	756	542
Sweetpotatoes and yams	417	213	359	253	274	205	220
All other vegetables				1, 723	407	996	396
Small fruits			27	209	25	102	24
Apples		<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
trees		56, 368	112, 019	84, 953	63, 931	64, 914	39, 509
Peaches		11, 783	25, 756	35, 084	30, 422	39, 533	22, 141
Other tree fruits		1, 266	6, 208	5, 872	11, 350	13, 368	11, 185

TABLE 3.—*Value of agricultural products, by classes, in Claiborne County, Tenn., for stated years, 1909-39*

Product	1909	1919	1929	1939
All crops harvested:				
All cereals	\$486, 819	\$1, 391, 432	\$531, 092	\$403, 384
Other grains and seed	2, 772	8, 492	560	298
Hay and forage	109, 675	594, 640	262, 383	256, 949
Vegetables for sale ¹	175, 585	368, 654	146, 733	69, 825
Vegetables for home use only ²			171, 876	196, 565
Tobacco			372, 620	412, 762
Fruits and nuts	59, 727	76, 940	63, 766	33, 262
All other field crops	61, 088	45, 801	5, 850	6, 292
Forest products sold			69, 509	22, 603
Livestock and livestock products:				
Animals sold and slaughtered	375, 721			311, 001
Value of domestic animals	1, 024, 770	1, 687, 403	992, 239	990, 024
Dairy products sold	86, 431	³ 222, 045	92, 492	61, 287
Poultry and eggs produced	176, 760	363, 296	473, 172	209, 072
Wool, mohair, and goat hair	2, 556	3, 541	1, 370	971
Honey and wax	4, 829	8, 920	3, 809	2, 215

¹ Includes potatoes and sweetpotatoes.

² Excludes potatoes and sweetpotatoes.

³ Includes all dairy products sold and for home use.

The data in table 2 indicate that there has been a large increase in the acreage used for growing hay and forage crops during the past 60 years. The acreage of wheat has been reduced, but the total production has increased moderately because of increases in acre yields. The acreage in oats has decreased markedly during this period, and at present the crop is of little importance. The acreages of barley and rye have always been small. Corn has always been the most important crop. Tobacco has become an important crop within the past 10 years.

According to table 3 the value of farm products increased in the decade between 1909 and 1919, but from 1919 to 1939 there was a sharp decline in value of most products except vegetables for home use and tobacco. These trends are largely an expression of price changes during the past 20 years, but some definite trends in real values are also indicated. In general the value of cereals has decreased during the period, whereas tobacco has increased. Trends of values of other products tend to be somewhat mixed, owing chiefly to fluctuations in markets and prices, however, rather than to any basic changes in the agriculture.

CORN

The acreage used for corn remained practically unchanged from 1879 to 1919. In 1929 it decreased considerably, and in 1939 corn was on 20,541 acres, which included about 40 percent of the harvested cropland. Yields increased from about 17 bushels an acre in 1879 to about 21 bushels in 1939. Corn is raised on all soils in all parts of the county, but the largest yields and acreages are in Powell Valley and the valleys of Little Sycamore and Big Sycamore Creeks. The county agent states that in 1939 the county was not growing enough corn for its own needs. Most of the crop is fed to livestock on the farms, but some corn is ground in local mills for use by the farm families.

WHEAT

Wheat has always been a moderately important crop. The acreage fluctuated somewhat during the decades from 1879 to 1919, but the total production increased steadily during that period because of increased yields. From 1919 to 1929 the acreage declined greatly, but a large increase—5,125 acres—is shown for 1939. Yields have shown a general upward trend, averaging slightly less than 5 bushels an acre in 1879 and slightly above 10 bushels in 1939. The decline in acreage was likely due to several factors, including unfavorable prices, opening of the extensive wheatlands in the Middle West in the early part of the twentieth century, and diseases and insects. Increased acre yields are accounted for largely by the increased use of commercial fertilizer, but improved varieties and better insect- and disease-control methods are also partly responsible for these increases. Wheat is grown in small acreages on many farms on all the soils of the uplands and colluvial lands in the cherty ridges and the limestone and shale valleys, as well as on the better drained soils of the bottom lands. The crop is harvested chiefly with binders but to some extent by hand with cradles. Most of it is threshed, but some is fed in the sheaf to livestock. The grain is used partly as feed for poultry and other livestock, but most of it is sold or exchanged for flour in Middlesboro, Ky.,

or other nearby cities, as Claiborne County is without mills for manufacturing wheat flour.

TOBACCO

The acreage in tobacco increased greatly between 1929 and 1939. Only 24 acres were grown in 1919, compared with 2,501 in 1939. Average yields increased from about 550 to 1,000 pounds an acre during the same period. Burley tobacco is grown in all parts except on Cumberland Mountain. The farmer usually selects his most productive areas for tobacco, and much is grown on Emory and Greendale soils in the cherty ridges, on Caylor soils in the limestone valleys, and on Jefferson and Leadvale soils in the shale valleys (pl. 5, *B*). Most of the crop is sold at auction in the tobacco warehouses in New Tazewell, although some is marketed in Knoxville. Tobacco is the most important cash crop in the county. No large farms raise it exclusively, but nearly every farm has a small patch. The average acreage per farm for the county is 0.8 acre, but the proportionate acreage is much larger on the small subsistence farms than on the larger general and livestock farms. In fact on small farms the sale of tobacco is the chief or, in some cases, the only source of cash income.

HAY

The acreage used for growing hay crops increased from 1,613 acres in 1879 to 18,321 in 1939, with no significant change in acre yields. In 1939 lespedeza was grown on about half the hay acreage and red clover, alone or with timothy, was the second most important hay crop. Increased use of lime and phosphate during the past few years has led to the growing of more leguminous hay crops, particularly alfalfa and sweetclover. Soybeans, cowpeas, crimson clover, and red-top are grown in small quantities. Lespedeza is grown on all soils of the county; alfalfa and clover chiefly on the more productive soils in the limestone valleys. Practically all hay crops are fed on the farms to work stock and to beef and dairy cattle, none going to outside markets.

MISCELLANEOUS SMALL GRAINS

In 1939 only 338 acres were in oats and 369 in barley. Parts of the two crops are cut green and fed as hay and the rest is harvested, threshed, and fed to poultry and livestock. Rye is inextensively grown and is now used chiefly as a winter cover crop and green manure.

OTHER MINOR CROPS

The acreages in potatoes and sorghums are small, but potatoes and sweetpotatoes are grown on practically all farms for home use. Surpluses may be marketed in Tazewell and Middlesboro. Production of sorghums has decreased markedly, from 38,878 gallons in 1879 to 9,633 in 1939. The sirup is used by the farm family and the fodder is fed to livestock.

Vegetables are relatively unimportant, although 996 acres in 1929 and 396 in 1939 were used for commercial vegetable production. Peas, beans, turnip greens, beets, cabbage, and spinach are grown chiefly for home use, although a few farmers in Powell Valley and in the vicinity

of Goins raise truck crops for sale in Knoxville and Middlesboro. Tomatoes are grown on 61 percent of the acreage and represent 58 percent of the value of all vegetables sold. They are grown principally on the Fullerton soils and are canned in several small canneries in the central part of the county. In recent years a few farmers have shipped fresh tomatoes to southern markets late in fall.

FRUITS

The number of apple trees declined from 112,019 in 1899 to 39,509 in 1939, and the number of peach trees from 25,756 to 22,141. No orchards are large but nearly every farm has a few fruit trees. The production of small fruits has varied from time to time but has at no time been important. In general, the yields of fruit are low and the quality poor. Most of the fruits are used in the home either fresh or preserved, but surpluses are sold in local markets. The farm income from the sale of fruits and nuts amounted to \$33,262 in 1940.

ROTATIONS AND FERTILIZERS

Systematic rotation of crops is not commonly practiced over much of Claiborne County, land use and management practices being determined largely by the needs of the farm operator and his family and the prices of farm products. A common practice is to grow a row crop, as corn or tobacco, for several years, followed by lespedeza or several years of idleness. In places row crops are raised in successive years until the natural fertility of the soil is exhausted; the land is then abandoned. Some of the more progressive farmers in the limestone valleys and other parts of the county use a rotation of corn or tobacco, wheat, and lespedeza.

Length of rotations is not ordinarily adjusted to the needs of individual soil types. The length of time the hay crop remains is determined largely by the size of the farm and the need for a more intensive crop. Clover or alfalfa is used as the hay crop in the rotation in some places but not extensively, largely because the farmers are unwilling or financially unable to meet the exacting requirements of these crops for amendments. Educational programs and subsidies have brought about significant increases in winter cover crops and green manures, but the acreage of unprotected soils in winter still remains large.

Expenditures for commercial fertilizer increased from \$738 in 1879 to \$60,475 in 1939, and the farms using fertilizer from 29.9 percent in 1909 to 77.1 percent in 1939. The gradual depletion of soil fertility through cropping and erosion, the clearing and cropping of less fertile soils because of population increases, education of farmers, and the recent rapid increase in tobacco growing have all contributed to the increased use of fertilizers.

Practically all the fertilizer is purchased by the individual and is factory-mixed. Most of it is used on wheat, corn, and tobacco. Usually either 0-16-0⁴ or 0-10-4 fertilizer is applied at the rate of about 150 pounds an acre on corn and wheat on all soils; the more successful tobacco growers use 3-8-5 at the rate of 500 to 1,200 pounds. Some farm-

⁴ Percentages, respectively, of nitrogen, phosphoric acid, and potash.



A, Comby Ridge in southeastern part of the county. Lehew soils on the comby steep to very steep ridge in background; Montevallo on the ridges in center; Philo and Leadvale in narrow valley on the right; Allen soil formed from sandy colluvium washed from Skaggs Ridge on sloping bench in the foreground.
B, Burley tobacco on Jefferson stony fine sandy loam in the valley of Big Sycamore Creek. Moderate to heavy fertilization is needed to obtain good yields.



A, Typical small subsistence farm on a narrow rolling ridge top in the Clarksville-Fullerton association of soils. The cleared areas are chiefly cherty Clarksville soils on rolling and hilly slopes; the forested areas chiefly cherty Clarksville soils on steep slopes. A wheat field is beyond the buildings; and corn, tobacco, and hay on the more distant fields.
B, Armuchee soils on cone-shaped knobs on the northeastern slope of Wallen Ridge.

ers, however, use 0-16-0 or 0-10-4 fertilizer supplemented with stable manure on their tobacco crop. Very little fertilizer is used on hay, although a few farmers use triple superphosphate on hay and pasture fields. Fertilizer dealers report the sale of some 2-10-4, 4-10-8, and sodium nitrate, but the county agent states that the use of these materials is not common. Practically all the mixed fertilizers have magnesian limestone as a filler. In general, little attention is given to specific soil needs, and the kinds and quantities of fertilizer used are determined by the amount the farmer has to invest.

There has been a large increase in the use of lime in the past few years. In 1939, 291 farmers used a total of 6,245 tons of liming materials. Lime is applied on all soils at the rate of about 2 tons of ground limestone or its equivalent an acre. The lime is usually applied to land being prepared for seeding to alfalfa, clover, lespedeza, or other legumes, but some is used on permanent pastures.

PASTURES

Pastures are important in Claiborne County, inasmuch as the sale of livestock and livestock products constituted the source of about one-fourth of the farm income in 1939. The county has nearly 50,000 acres of plowable pasture, and the total acreage of pasture is considerably larger if the nonplowable and woodland pastures are included. The largest areas of pasture land are in Powell Valley, especially northeast from Arthur to the county line, in Cedar Fork Valley, in the valley of Little Sycamore Creek, and in the vicinity of Lone Mountain. The quality of pasture is somewhat variable, depending upon management, but bluegrass is generally the chief pasture plant. Where soil amendments have been used, pastures may consist largely of clovers, whereas in untreated, severely eroded places, broomsedge may be the dominant pasture plant. In the rest of the county most of the pastures are on hilly and steep slopes, on cherty or stony soils, or on poorly drained soils in the bottom lands. In general these pastures are of poor quality and consist chiefly of broomsedge, although bluegrass and clovers may be grown where lime and phosphate are used.

LIVESTOCK AND LIVESTOCK PRODUCTS

The livestock of Claiborne County consists of dairy and beef cattle, hogs, sheep and goats, poultry, bees, and work stock.

DAIRY COWS

In 1939 there were 5,562 dairy cows in the county, and since 1920 there has been no significant change in the number. The value of dairy products sold increased from \$50,815 in 1920 to \$61,287 in 1940. No large commercial dairies are in the county, but a few small dairy farms are in Powell and Big Sycamore Valleys, and about 86 percent of the farms have enough dairy cows to furnish milk and butter for the farm family. Surpluses are sold in local markets, and the dairy farms truck their milk to Middlesboro, Ky., and Morristown, Tenn. The principal dairy breeds are Jersey and Guernsey, and most dairy animals are grades of these two.

BEEF CATTLE

The best quality and the greatest number of beef cattle are raised in the valley of Little Sycamore Creek and in Cedar Fork and Powell Valleys. Beef cattle are also on the less steep cherty ridges, but very few are raised on the steep cherty ridges, on the shale ridges, or on Cumberland Mountain. The principal breeds are Hereford and Aberdeen-Angus. In 1940 there were 534 cows kept mainly for raising beef calves. Purebred sires are cooperatively owned in several communities. Some of the choicest cattle are sold in Knoxville for beef, and a few animals are shipped to Cincinnati markets, but most of them are sold as 2-year-old feeders to stockmen from southwestern Virginia, who fatten them for sale in eastern markets.

SWINE

The number of swine in the county decreased from 10,553 in 1920 to 6,165 in 1940. There are a few hogs on nearly all farms, but the county has no large swine producers or breeders. It does not produce enough pork for its own needs (1940), and all hogs are used on the farms or sold in local markets. The principal breeds are Hampshire, Poland China, and Duroc-Jersey.

SHEEP AND GOATS

In 1940, 869 sheep were raised in the county as compared with 2,107 in 1920. These are in small scattered flocks. Wool and lambs are sold in local markets, and some lambs are slaughtered for home use. The principal breed is Shropshire. Only 193 goats were raised in 1940.

POULTRY

In 1940 there were 112,593 chickens and 671 turkeys over 4 months old on the farms. Small numbers of ducks, geese, and guinea fowls also are raised. There are no specialized poultry farms, but chickens are raised on 91 percent of the farms, and the sale of poultry and poultry products accounted for 7.1 percent of the farm income in 1940. The principal breeds of chickens are Plymouth Rock, Rhode Island Red, and white Leghorn, but small numbers of several other breeds also are raised. Poultry and poultry products are used on the farm, and surpluses are sold chiefly in local markets, although in recent years cooperative shipments of poultry have been made to eastern markets late in fall.

BEES

In 1940 bees were kept on 592 farms, and 13,844 pounds of honey were harvested. Most of the honey is used in the farm homes, but some honey and wax were sold in local markets. Farm incomes in 1940 from this source amounted to \$2,215.

WORK STOCK

Work animals on farms numbered 6,328 in 1920, of which 56 percent were horses and 44 percent mules. By 1940 the total number of work animals had declined to 4,061, equally divided between horses and

mules. Because of this marked decline and the increase in the number of farms, the average number of work animals to the farm decreased from 2.1 in 1920 to 1.3 in 1940. The work stock is predominantly of Belgian and Percheron breeding. The quality of stock is good and is mostly of small to medium-sized animals, adapted to use in the comparatively rough topography.

TYPES OF FARMS

Of the 3,081 farms in the county, 2,131 (about 69 percent) were self-sufficing, that is, the chief farm enterprise consisted of growing farm products for the use of the farm family (pl. 6, A). Of the remaining farms, 732 derived their major income from the sale of general field crops, 167 from livestock and livestock products, 9 from specialty crops, and 9 from forest products.

The farms are classified according to size into the following groups:

Acres:	Number of farms	Acres:	Number of farms
3 to 9.....	401	180 to 219.....	54
10 to 29.....	812	220 to 259.....	13
30 to 49.....	640	260 to 379.....	28
50 to 69.....	449	380 to 499.....	9
70 to 99.....	336	500 to 699.....	6
100 to 139.....	214	700 to 999.....	2
140 to 179.....	114	More than 1,000.....	3

About 61 percent of the farms have less than 50 acres, and 86 percent less than 100 acres. The last two decades showed a large increase in the number of farms of less than 100 acres and corresponding decreases in the number of larger farms.

In general, the distribution of the different types of farms, when considered either from the standpoint of size or type, is a direct expression of soil and land conditions. In the steep cherty ridges and in the shale ridges, where soil and land conditions are unfavorable, the farms are predominantly of the self-sufficing type, often of small total acreage and almost invariably with small acreages of cropland. The general farms are principally in the limestone valleys, but a few are on the smoother cherty ridges and on the better soils of the shale valleys. In all these areas there are relatively large acreages of productive soils and favorable land conditions. These farms usually are larger and have a larger acreage in growing crops than do the subsistence farms. The livestock and dairy farms are chiefly in the limestone valleys, where there is much land suited to pasture. They are comparatively large, often exceeding 150 acres. The farms growing specialty crops are in various parts of the county, their locations probably determined more by the interests of the farm operator than by land conditions.

LAND USE

The period of greatest growth and development in Claiborne County extended from 1880 to 1910. The population increased from 13,373 to 23,504 and the number of farms from 1,740 to 3,238. During that period the land in farms remained nearly constant, but there was an increase in improved land. From 1910 to 1940 both the size of farms and the area of improved land to the farm declined. The

average size decreased from 138 acres in 1880 to 71.8 in 1910, and the improved land to the farm decreased from 48 to 39 acres. From 1910 to 1940 the number of farms did not change significantly, but the acreage of farms decreased about 18 percent and of improved land about 9 percent. The average size of farms decreased to 55.6 acres, and the improved land decreased to 34.8 acres to the farm.

The decrease in land in farms in the last three decades has been due largely to changes in ownership. The American Association, a privately owned land-holding company, has acquired ownership of practically all the land in the Cumberland Mountain area and the Tennessee Valley Authority purchased several thousand acres bordering the Norris Reservoir.

Woodland on farms has decreased in the past 30 years from 72,801 acres in 1919 to 59,067 in 1929, and to 47,527 in 1939. At present about 17 percent of the county area, or 28 percent of the farm area, is in farm woodland.

During the last two decades there has been a large increase in the acreage of hay and forage crops and a corresponding decrease in that of intertilled crops, except tobacco, which has increased greatly. During the last 10 years the acreage of small grains has nearly doubled.

In 1940 about 60 percent of the land of the county was classified as being in farms. About 29.6 percent of this is classified as harvested cropland, 3.8 percent as idle cropland, 0.6 percent as crop failure, 28.7 percent as plowable pasture, and 27.7 percent as woodland. The remaining 9.6 percent was used for barn sites and barn lots, home sites and lawns, lanes, roads, and other noncrop purposes. Of the cropland harvested, about 41 percent was in corn, 36 percent in hay and forage crops, 10 percent in wheat, 1.5 percent in other small grains, 5 percent in tobacco, and 6.5 percent in all other crops, including potatoes, sweetpotatoes, sorghums, fruits, and vegetables.

FARM TENURE

About 84.5 percent of the farms in the county are operated by owners, 2.5 percent by part owners, and 13 percent by tenants. Although there have been small fluctuations in the percentages of farms operated by owners and by tenants, there has been no significant change since 1880. The percentage of farms operated by managers, which has always been low, decreased from 0.2 percent in 1900 to 0.03 percent in 1940.

In 1940, 106 tenants paid cash rent, 237 were share tenants, and 57 were tenants of other kinds. Share tenants who furnish labor only receive half the tobacco and one-third of the other crops. When the tenant furnishes labor, work stock, and half the commercial fertilizer he receives half the tobacco and two-thirds of all other crops. When the tenant furnishes work stock, implements, seed, all fertilizer, and his own labor he receives two-thirds of all crops, including tobacco. The lease is usually an unwritten agreement for 1 year, terminating after the crops are harvested and before the succeeding crop is to be planted, usually during January. In the absence of a written agreement, there is no provision for notice of termination or renewal.

FARM INVESTMENTS AND EXPENDITURES

In 1940 the average value of farms was \$2,746. Of this value 83.9 percent was in land and buildings, 11.7 percent in domestic animals, and 4.4 percent in implements. The average value of land, including buildings, was \$41.47 per acre.

Heavy farm machinery is comparatively scarce. Less than 1 percent of the farms have tractors, and only about 9 percent have trucks. There are no combines, and such implements as corn binders, hayloaders, side-delivery hay rakes, and riding plows are rare. Machinery in the better agricultural communities includes walking plows, one-row cultivators, one-row corn drills, small-grain drills, spike-tooth harrows, mowing machines, dump hay rakes, disk harrows, and some grain binders. On the smaller subsistence farms, machinery of any kind is scarce; most of the farm operations are carried on by hand by the farm operator and his family.

The total amount spent for feed increased from \$19,199 in 1910 to \$51,612 in 1940 and the percentage of farms purchasing feed increased from 18.5 percent to 41.6. Feeds purchased consist chiefly of concentrated feeds for dairy cows and poultry and corn for swine in areas of low corn production.

Expenditures for farm labor declined from \$186,892 in 1910 to \$91,737 in 1940, and the number of farms reporting such expenditures decreased from 1,805 to 886. These decreases can be accounted for by the increase in number of farms and their marked decrease in size. The present supply of farm labor is adequate as to both quantity and quality and consists chiefly of native whites, although a few Negroes are employed on farms.

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 content of lime in the soil profile is determined by simple tests.⁵ Other features taken into consideration 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 on the features that influence the adaptation of the land to the production of crop plants,

⁵ The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the reaction. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

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. In some places two or more of these principal units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a small-scale map but must be mapped as (4) a complex. Some areas that have no true soil—as Rough stony land, Rough gullied land, or Mine dumps—are termed (5) miscellaneous land types.

The most important of these groups is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the 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. Dewey, Fullerton, Clarksville, and Muskingum are names of important soil series in Claiborne County.

Within a soil 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. For example, Fullerton silt loam and Fullerton loam are soil types within the Fullerton series. Except for the texture of the surface soil, these types have approximately the same internal and external characteristics.

A phase is a subdivision of the type. Some soil types possess a narrow range of characteristics and hence are not divided into phases; others, with a wider range of characteristics, are mapped in two or more phases. The phases of a type differ from one another, generally with respect to external soil characteristics, such as slope or degree of erosion. For example, if a soil type has slopes that range from 5 up to more than 25 percent, it may be mapped in three phases—a rolling phase (5- to 12-percent slopes), a hilly phase (12- to 25-percent slopes), and a steep phase (25+-percent slopes); or a soil that has been eroded in places may be mapped in two or more phases—an uneroded phase, an eroded phase, and perhaps a severely eroded phase. One of the phases of a soil type generally is of more common occurrence than the others. Such a phase is considered to be the normal phase of the type and, in this report, bears no phase designation. Fullerton silt loam, for example, is divided into three phases: (1) Fullerton silt loam (the normal, or rolling, phase); (2) Fullerton silt loam, hilly phase; and (3) Fullerton silt loam, steep phase.

Examples of soil complexes are found in Talbott-Hayter silt loams and Talbott-Hayter silt loams, steep phases, in which the soils are so intimately associated that they cannot be separated on a map of the scale used.

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

scape. In Claiborne County three types of base maps are used: (1) Planimetric maps which are compiled from aerial photographs and are adjusted to United States Geological Survey points of control, (2) aerial mosaics that are made by fitting together several individual aerial photographs into a single map, and (3) individual single-lens aerial photographs. All these maps are on a scale of 1:24,000, which equals 2.64 inches a mile. The soil surveyor mounts a section of a map on a small plane table equipped with a magnetic compass and, traveling on foot, systematically traverses the area represented by the map. As he proceeds he makes frequent examinations of the soil and plots on the map the boundaries of each type, phase, complex, and miscellaneous land type as they occur in relation to roads, houses, streams, lakes, and other local cultural and natural features of the landscape. When the field work is completed the field sheets are assembled and from them a single large map of the entire county is drafted.

Texture refers to the relative quantities of clay, silt, and various grades of sand making up the soil mass. Coarse-textured soils contain much of the coarse material (sands), and fine-textured ones contain much fine material (clay). Structure refers to the natural arrangement of the soil material into aggregates, structural particles, or masses. Consistence refers to the relative mutual attraction of the particles in the whole soil mass or their resistance to separation or deformation (as evidenced in cohesion and plasticity). Consistence is described by such general terms as loose or open; slightly, moderately, or very compact; mellow; friable; crumbly; plastic; sticky; soft; firm; hard; and cemented. Permeability and perviousness connote the ease with which water, air, and roots penetrate the soil. The A horizon is the lighter textured and leached surface layer of the soil. The B horizon is the heavier textured and usually the darker colored layer underlying the A horizon. The A and B horizons taken together form the solum, or the true soil. The C horizon is the parent material, or unconsolidated weathered rock material upon which the B horizon rests. Surface soil refers to the part of the solum that is disturbed by ordinary tillage operations. The subsoil is roughly that part of the solum below plow depth. Soil reaction is the degree of acidity or alkalinity of the soil mass expressed in pH values, or in words as follows: (4)

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

In a practical sense reaction may be defined as the relative richness or poverty of the soil in lime (available calcium). An acid soil is one that requires the addition of lime for maximum production of most crops, a neutral soil contains sufficient lime for any commonly grown crop, and an alkaline soil is one rich in lime. A stony or cherty soil contains sufficient stone or chert to interfere with, but not prevent, tillage of the land. Land that is too stony for cultivation is designated as stony land or rockland. Level land (A slope class) is characterized by slow surface runoff and no accelerated erosion, and heavy farm machinery can be used easily.

Undulating land (B slope class) has adequate but moderately slow surface drainage, erosion is controlled with comparative ease, and heavy machinery may be used freely. Rolling land (C slope class) has moderate to very rapid surface drainage. Adapted crop rotations and in places mechanical means are necessary for control of erosion, and moderate resistance is offered to the use of heavy farm machinery. Hilly land (D slope class) has rapid surface drainage. Careful selection and rotation of crops supplemented by mechanical devices are necessary for control of erosion, and the use of heavy farm machinery is generally impractical. Steep land (E slope class) has very rapid surface runoff. Erosion cannot be controlled under crops, and use of heavy farm machinery is entirely impractical. Very steep land (F slope class) has the undesirable characteristics of steep land developed to an even greater degree.

Soil amendment, as used in this report, refers to any material added to the soil for the purpose of improving conditions for plant growth. Lime, fertilizer, and manure are soil amendments. A fertilizer, as here used, refers to any commercially obtainable material that contains one or more of the three essential chemical elements—nitrogen, phosphorus, and potash—in such forms that when the material is applied to soils, crops can make use of them for their processes of growth. A mixed fertilizer contains two or more of these essential elements; a complete fertilizer contains all three; a low-grade fertilizer contains less than 16 percent of plant foods, and a high-grade fertilizer contains more than 16 percent. The minor elements, or secondary elements, are those that ordinarily are in the soil and are required by plants in only relatively small quantities. They include sulfur, magnesium, iron, manganese, boron, copper, and zinc. Manure or barnyard manure is a mixture of animal excrement, bedding, and litter that accumulates in stables. Lime is either the carbonate or hydroxide of calcium or calcium and magnesium applied to the land primarily for neutralizing soil acidity but also as a source of calcium for plants.

SOILS

The general characteristics of the mature soils of the uplands of Claiborne County have been determined largely by the climate and vegetation under which they formed. They have developed in an environment of moderately high temperature, heavy rainfall, and deciduous forest vegetation and are characterized by friable grayish-brown silt loam A horizons and red or yellowish-red B horizons containing a relatively large quantity of clay. These soils are highly leached and are therefore low in plant nutrients and strongly acid in reaction. In general they are lighter in color, lower in organic matter, much more acid in reaction, and consequently much less productive of crop plants than are the dark soils of the central United States. Some of the upland soils, however, are probably more productive than are the more highly leached soils of areas farther south and southeast.

Although the general characteristics of the soils as a whole are an expression of climatic conditions and vegetation, the individual characteristics of any particular soil are chiefly a reflection of the kind

and age of its parent material. The soils have formed from parent material derived from many different sedimentary rocks. As a result of these wide differences in parent material, the soils of the county exhibit a wide range in color, texture, consistence, depth, reaction, conditions of stoniness and erosion, and, accordingly, a wide range of productivity and workability.

The soils vary in color from very light gray to brown in the A horizon and may be red, yellow, brown, or gray in the B horizon. Textures vary from fine sandy loam to silty clay. Most of the soils have a friable A horizon, but the B horizon ranges from mellow and friable to very sticky and tenacious. The organic-matter content generally is low but varies somewhat because of local differences in the original vegetative cover under which the soils formed and to the present use and management. The depth of the solum varies from a few inches to several feet, and depth over bedrock ranges from less than 2 feet to more than 50. All upland soils are acid in reaction, but some soils of the stream bottom lands are neutral or slightly alkaline.

About 20 percent of the soils of the county are classified as silt loam; 22 percent, cherty silt loam; 9 percent, cherty loam; 20 percent, stony fine sandy loam; 10 percent, all other textural classes; and 19 percent, miscellaneous land types. Approximately half the area has had little or no damage by accelerated erosion, but about 2 percent of the land has been reduced to a network of gullies and the rest has been eroded sufficiently to reduce productivity considerably and limit somewhat the use suitability. About 58 percent of the land has steep slopes; 21 percent, hilly; 15 percent, rolling; and 6 percent, level to undulating. About 3 percent is poorly drained. Only about 3 percent of the soils are neutral in reaction; the rest require lime to obtain good crop yields. About 25 percent of the area has stone-free soils; 56 percent, stony or cherty soils; and 19 percent, soils too stony for cultivation.

When the soils are grouped on the basis of their use capability, which is determined largely by their characteristics, and their extent of development and combinations of characteristics, about 21 percent of the area is covered by soils suited to cultivated crops, 25 percent to pasture, and 54 percent to forest. Taking the average of the Great Valley of East Tennessee as a standard, only about 3 percent of the land suited to cultivation is relatively high in productivity, whereas 37 percent is medium, and 60 percent is low.

Variations in soil and land conditions and the consequent suitability of these soils to various uses has largely determined the local differences in agriculture within the county. The thin, stony, impoverished soils and the rugged relief of Cumberland Mountain have inhibited agricultural development. Land in this area is owned largely by a single corporation that leases coal and lumber concessions to contractors. The few farms are of the subsistence, or part-time, type with very low crop yields, a few livestock of poor quality, and improved farm practices are not followed.

In contrast to Cumberland Mountain, Powell Valley has level to rolling topography, and the soils are moderately fertile and are well suited to a wide variety of crops. These desirable lands attracted the earliest settlers and comparatively large farms were established. A fairly stable and diversified agriculture has developed, and, in general,

crop yields are superior to those of any other part of the county. Similar soil and land conditions in Cedar Fork Valley and the valley of Little Sycamore Creek have led to a similar type of agriculture, although the presence of relatively larger areas of soils suited to growing pasture has led to a greater emphasis on livestock production.

Although scattered areas with favorable land conditions and moderately fertile soils are on the cherty ridges, relatively unproductive cherty soils chiefly characterize the steep land. Unfavorable soils and land conditions also prevail in the shale ridges in the southeastern part of the county. In these areas small subsistence farms have been established where farm practices are determined almost entirely by the immediate needs of the farm family. The resultant intensive cropping of these relatively infertile soils leads to their rapid depletion and to progressively poorer yields and lower living standards.

SOIL SERIES AND THEIR RELATIONS

On the basis of differences in characteristics, the soils of Claiborne County are mapped in 39 types, 36 phases,⁶ 1 complex, and 11 miscellaneous land types. In order to use this report to the best advantage it is necessary to become familiar with the soils and to understand their relations to each other. The soils are placed in four main groups on the basis of their position in the landscape and on the source of their parent materials as follows: (1) Soils of the uplands, (2) soils of the colluvial lands, (3) soils of the terrace lands, and (4) soils of the bottom lands.

The soils of the uplands are on the higher elevations above the stream valleys. They are underlain by consolidated bedrock from which their parent material has weathered. On the basis of differences in the kind of underlying rocks, these upland soils are divided into four subgroups, namely, soils of the uplands derived from (1) limestone residuum, (2) cherty and sandy dolomite residuum, (3) interbedded limestone and shale residuum, and (4) acid sandstone and shale residuum.

Soils of the colluvial lands are on sloping fans and benches on the foot slopes of hills and in the bottoms of lime sinks and depressions. Their parent materials are derived from mixed and unstratified soil materials and rock fragments washed and rolled from the immediately adjacent upland slopes. Two subgroups based on differences in the general character of the parent materials are recognized: Soils of the colluvial lands derived chiefly from materials washed from uplands underlain (1) by limestone and dolomite and (2) by sandstone and shale with some limestone influence.

The soils of the terrace lands are on the second-bottom lands or benches along streams and rivers, but they are ordinarily not subject to overflow. Their parent materials are derived from old stream alluvium deposited when the streams were flowing above present levels. These terrace deposits are stratified in many places and consist of alternate layers of sand, silt, clay, and gravel. The soils of this group are divided into two subgroups on the basis of differences in the

⁶ When a soil type is subdivided into phases, that part of the type that bears no phase name is referred to as the normal phase of the type.

origin of their parent materials: Soils of the stream terraces derived from old alluvium (1) chiefly from limestone material and (2) chiefly from sandstone and shale materials.

The soils of the bottom lands are on the flood plains of streams and rivers and are subject to annual overflow. Their parent materials, which are sorted and stratified in many places into layers of sand, silt, clay, and gravel, are recent stream alluvium deposited by flood waters. On the basis of general differences in parent materials this group is divided into two subgroups: Soils of the bottom lands derived from alluvium washed (1) chiefly from limestone material and (2) chiefly from sandstone and shale materials.

The foregoing groups include all the soil series mapped in the county. In addition there are miscellaneous land types that include areas of land having little or no true soil because of the large number of bedrock outcrops or the severe erosion. All the soil series mapped in the county are listed in table 4 according to this grouping. Some of the more important properties of the soils are tabulated and the relations of the various soils to each other are shown. Study of this table will enable the reader to understand and use this report more readily.

SOILS OF THE UPLANDS DERIVED FROM LIMESTONE RESIDUUM

The soils of the uplands derived from limestone materials are of the Dewey, Talbott, and Colbert series. These soils are closely associated with one another in the low-lying limestone valleys.

The Dewey soils have a light-brown or grayish-brown silt loam surface soil and a yellowish-red, light-red, or red silty clay subsoil. The Talbott soils differ from the Dewey soils chiefly in that the subsoil is lighter in color and is more compact, sticky, and plastic. The Colbert soil, as mapped in Claiborne County, has a gray silty clay loam surface soil and a yellow or greenish-yellow sticky plastic silty clay subsoil. In general the depth of solum and fertility decreases from Dewey to Talbott to Colbert soils. On similar slopes workability and conservability decrease in the same order.

SOILS OF THE UPLANDS DERIVED FROM CHERTY AND SANDY DOLOMITE RESIDUUM

Soils of the uplands derived from cherty and sandy dolomite residuum are of the Bolton, Claiborne, Fullerton, and Clarksville series. They are on rolling to steep slopes and crests of the high valley ridges underlain by cherty and sandy dolomites. Their wide variation in productivity, workability, and conservability depends upon slope, degree of accelerated erosion, tilth and moisture conditions, natural fertility, and past and present use and management. This group of soils includes 120,179 acres, or about 42 percent of the area of the county.

The Bolton soils have a friable dark reddish-brown surface soil and a friable dark-red subsoil. Claiborne soils differ from the Bolton soils in that they have a light-brown surface layer, a yellowish-brown subsoil, and a more sticky and compact substratum. The Fullerton soils have a gray or brownish-gray friable surface soil and a light-red or yellowish-red clayey subsoil, whereas the Clarksville soils have a lighter gray surface soil and are yellow or brownish yellow rather than red

in the subsoil. The quantity of chert in the soils increases in the order in which they are listed, the Bolton soils being practically chert-free and the Clarksville generally very cherty. The content of lime, organic matter, and mineral plant nutrients decreases in the same order. In general, these soils are less fertile than the soils of the limestone valleys, but good tilth is ordinarily more easily maintained. On similar slopes, erosion is less severe and the soils are less susceptible to further erosion.

SOILS OF THE UPLANDS DERIVED FROM INTERBEDDED LIMESTONE AND SHALE RESIDUUM

The soils of the uplands derived from interbedded limestone and shale residuum are of the Armuchee and Sequoia series underlain by interbedded limestone and shale, but the Armuchee is on the slopes of valley mountains and ridges, whereas the Sequoia is in low valleys.

The Armuchee soils have a yellowish-brown surface layer and a brownish-red subsoil with bedrock at a shallow depth. Slopes are hilly and steep. The Sequoia soil differs from the Armuchee chiefly in that it has milder slopes, thicker soil layers, and a greater depth to bedrock. It has a grayish-brown surface soil underlain by a brownish-yellow silty clay loam subsoil. In general, these soils are higher in lime and organic matter and more fertile than soils on comparable slopes in the cherty ridge sections, but they are less favorable in these respects than limestone valley soils.

SOILS OF THE UPLANDS DERIVED FROM SANDSTONE AND SHALE RESIDUUM

The soils of the uplands derived from sandstone and shale residuum consist of the Lebew, Montevallo, Muskingum, and Hartsells series. These soils are underlain by acid rocks that are strongly resistant to weathering, and with the exception of the Hartsells soil, have hilly and steep slopes and shallow, weakly developed profiles. The Hartsells soil is a relatively shallow, sandy soil having a more distinctly developed profile and milder slopes. These soils are probably lower in natural fertility than the other upland soils in the county. From the standpoint of acreage this is one of the more important groups of soils, but it is relatively unimportant for agriculture because very little of the soil is suited to either crops or pasture.

The Montevallo soils are thin brownish-gray shaly soils on hilly and steep knobs underlain by green, yellow, purple, red, and gray fissile acid shale. The Lebew soils are on steep, sharp-crested valley ridges underlain by purple, red, and green interbedded sandstone and shale. The soils are dominantly brown or purplish-brown fine sandy loam, but as mapped they are not uniform in color. The Muskingum soils are shallow sandy soils with a grayish-yellow or yellow surface layer and a yellow subsoil on mountain slopes underlain chiefly by massive sandstone and conglomerate but also in some places by acid shale. The Hartsells soil is on the rolling crests and benches of the lower mountains underlain by massive sandstone and conglomerate. The yellowish-gray fine sandy loam surface soil is underlain by a yellow stony fine sandy clay loam subsoil.

TABLE 4.—Characteristics of soil series in Claiborne County, Tenn.

SOILS OF THE UPLANDS

Series and topographic position	Parent material	Relief	Drainage		A and B horizons							
			External	Internal	Surface soil (A horizon)				Subsoil (B horizon)			
					Color	Texture	Consistence	Thick-ness	Color	Texture	Consistence	Thick-ness
				Inches				Inches				
Valley troughs: Colbert..... Talbot.....	Residuum from— Clayey limestone..... Slightly clayey lime- stone.	Undulating to rolling..... Undulating to steep.....	Moderate..... do.....	Slow..... do.....	Shallow soil; 5 inches gray or dark-gray silty clay loam underlain by yellow or greenish-yellow tough plastic silty clay; bedrock at 24 inches. Grayish brown.....	Silt loam.....	Moderately friable.....	6-8	Yellowish red.....	Silty clay.....	Tough, plastic.....	18-24
Valley slopes: Sequoia..... Dewey.....	Interbedded shale and limestone..... High-grade or slightly cherty limestone.	Rolling..... Undulating to steep.....	do..... do.....	Retarded..... Moderate.....	do..... Grayish brown or light brown.	Silty clay loam..... Silt loam.....	do..... Friable.....	6 8-12	Brownish yellow..... Yellowish red or red.....	Silty clay loam..... Silty clay.....	Sticky, plastic..... Moderately sticky.....	18-24 30-36
High round-topped cherty ridges: Bolton..... Claiborne..... Fullerton..... Clarksville.....	Cherty and/or sandy dolomites..... do..... do..... do.....	Rolling to steep..... do..... do..... do.....	do..... do..... do..... do.....	do..... do..... do..... do.....	Dark reddish brown..... Light brown..... Gray or brownish gray..... Light gray.....	do..... do..... Silt loam or loam..... do.....	Friable, mellow..... do..... Friable..... Loose, open.....	12 10-12 8-12 8-10	Dark red..... Yellowish brown..... Yellowish red or light red..... Yellow or brownish yellow.	Silty clay loam..... do..... do..... Silty clay loam or fine sandy clay.	Friable..... Moderately friable..... do..... Loose, brittle.....	40-50 18-24 24-30 18-24
Cone-shaped knobs and steep ridges: Armuchee..... Montevallo.....	Interbedded limestone and shale..... Acid shale.....	Hilly to steep..... do.....	Rapid..... do.....	do..... Rapid.....	Shallow soil; yellowish-brown silt loam underlain by brownish-red silty clay mixed with shale; bedrock at 24 inches. Shallow soil; brownish-gray shaly silt loam; bedrock at 8 to 24 inches.							
Comby ridges: Lehew.....	Interbedded shale and sandstone.	do.....	do.....	do.....	Shallow soil; brown or purplish-brown fine sandy loam mixed with shale and sandstone fragments; bedrock at 12 to 18 inches.							
Even-crested high ridges and mountains: Muskingum..... Hartsells.....	Massive sandstone and conglomerate, some shale..... do.....	do..... Undulating to rolling.....	do..... Moderate.....	do..... Moderate.....	Shallow soil; grayish-yellow or yellow fine sandy loam underlain by brownish-yellow fine sandy loam or sandy clay loam; bedrock at about 20 inches. Yellowish gray..... Fine sandy loam..... Friable..... 6 Yellow..... Stony fine sandy clay loam. Moderately friable..... 24							

SOILS OF THE TERRACE LANDS

Level to sloping stream terraces: Etowah.....	Old alluvium chiefly from— Limestone.	Gently sloping to sloping.....	Moderate.....	Moderate.....	Grayish brown or light brown.....	Silt loam.....	Moderately friable.....	6-10	Brownish red.....	Silty clay loam.....	Moderately sticky.....	18-24
Taft.....	do.....	Nearly level.....	Slow.....	Slow.....	Light gray.....	do.....	Loose, floury.....	8	Grayish yellow to bright yellow.	Clay loam to silty clay loam.	Friable to compact.....	15-20
Robertsville.....	do.....	Level or slightly de- pressed.	Very slow.....	Very slow.....	do.....	Clay loam.....	Moderately sticky.....	3-4	Mottled gray.....	Silty clay.....	Sticky, plastic.....	10-15
Waynesboro.....	Acid sandstone and shale.....	Gently sloping to roll- ing.	Moderate.....	Moderate.....	Grayish brown to light brown.	Fine sandy loam.....	Friable.....	4-6	Red or yellowish red.....	Fine sandy clay.....	Friable.....	18-24
Sequatchie.....	Acid sandstone.....	Nearly level to sloping.....	do.....	do.....	Light brown.....	do.....	do.....	10-15	Yellowish brown.....	Sandy clay loam.....	do.....	10-20
Holston.....	Acid sandstone and shale.....	do.....	Moderate to slow.....	Slow.....	Gray to grayish yel- low.	do.....	Loose, open.....	8-10	Yellow to brownish yellow.	Silt loam to fine sandy clay.	Rather brittle.....	10-20
Monongahela.....	do.....	Nearly level.....	Slow.....	do.....	Grayish brown to gray.	Silt loam.....	Floury.....	6-8	do.....	Silt loam or silty clay loam.	Brittle.....	12-18
Tyler.....	Acid shale.....	Level or slightly de- pressed.	Very slow.....	Very slow.....	Light yellowish gray.....	do.....	do.....	4-5	Mottled yellowish gray.	do.....	Sticky, plastic.....	24-36

SOILS OF THE COLLUVIAL LANDS

Foot slopes and bottoms of lime sinks: Emory.....	Local slope wash from— Bolton, Dewey, and Claiborne soils.	Gently sloping to slop- ing.	Moderate.....	Moderate.....	Young soil; mellow friable heavy brown silt loam 3 to 5 feet thick.							
Greendale.....	Clarksville and Fullerton soils.	Nearly level to sloping.....	do.....	do.....	Young soil; gray or light grayish-brown friable silt loam underlain by cherty brownish-yellow or yellow silt loam or silty clay loam.							
Ooltewah.....	Talbot, Dewey, Clarks- ville, and Fullerton soils.	Nearly level.....	Poor.....	Moderately slow.....	Young soil; light-brown or grayish-brown silt loam underlain by mottled gray silty clay loam.							
Guthrie.....	do.....	do.....	Very slow.....	Very slow.....	Young soil; mottled gray or yellowish-gray silt loam underlain by mottled yellowish-gray light silty clay loam grading to silty clay.							
Valley fans and foot slopes: Caylor.....	Armuchee, Talbot, Le- hew, and Muskingum soils.	Gently sloping to slop- ing.	Moderate.....	Moderate.....	Brown.....	Silt loam.....	Friable, mellow.....	8-12	Yellowish brown.....	Silty clay loam.....	Moderately friable.....	20-23
Hayter.....	do.....	Gently to strongly sloping.	do.....	do.....	do.....	Loam to silt loam.....	Friable.....	12-18	do.....	do.....	Friable.....	24-36
Leadvale.....	Montevallo and Lehew soils.	Nearly level to sloping.....	Moderately slow.....	Slow.....	Light grayish brown or grayish yellow.	do.....	do.....	10-15	Yellow.....	do.....	Moderately friable.....	10-14
Allen.....	Muskingum soils and Rough stony land (Muskingum soil ma- terial).	Rolling.....	Moderate.....	Moderate.....	Grayish brown to brown.	Loam.....	do.....	6-8	Yellowish red to red.....	Fine sandy loam to sandy clay loam.	do.....	30
Jefferson.....	do.....	Gently sloping to slop- ing.	do.....	do.....	Gray or yellowish gray.	Fine sandy loam.....	Loose, open.....	6-8	Brownish yellow.....	Silty clay loam or sandy clay loam.	Friable.....	24

SOILS OF THE BOTTOM LANDS

Flood plains of stream val- leys: Roane..... Lindside..... Melvin..... Dunning..... Pope..... Philo..... Atkins.....	Young stream alluvium chiefly from— Cherty dolomite..... Limestone and dolomite. do..... Clayey limestone..... Acid sandstone and shale. do..... do.....	Nearly level..... do..... Level..... do..... do..... do..... Level.....	Moderate..... do..... Very slow..... do..... do..... do..... Very slow.....	Slow..... do..... Very slow..... do..... do..... do..... Very slow.....	Young soil; brown silt loam underlain by light-brown to yellowish-brown cherty silt loam; medium acid. Young soil; brown silt loam 8 to 12 inches thick underlain by mottled gray silty clay to silty clay loam; medium acid. Young soil; mottled gray silt loam; medium acid. Young soil; almost black surface soil underlain by sticky, plastic gray mottled silty clay. Young soil; grayish-brown fine sandy loam underlain by yellow or brownish-yellow fine sandy loam; medium to strongly acid. Young soil; grayish-brown fine sandy loam underlain by mottled gray fine sandy loam. Young soil; mottled gray silt loam underlain by heavier textured layers; strongly acid.							
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SOILS OF THE COLLUVIAL LANDS DERIVED CHIEFLY FROM MATERIALS WASHED FROM UPLANDS UNDERLAIN BY LIMESTONE AND DOLOMITE

The soils of the colluvial lands derived chiefly from materials washed from the uplands underlain by limestone and dolomite are in the cherty ridge sections and the limestone valleys of the county. This group is composed of the Emory, Greendale, Ooltewah, and Guthrie series. They are in the bottoms of lime sinks or on sloping benches along small intermittent streams of these areas. Their parent materials are rock fragments and soil material that has been moved by rolling and local washing from the immediately adjoining uplands to their present position. The soils do not have well-developed profiles. Although the total acreage is small, these soils are very important from the standpoint of agriculture because they are generally medium to high in fertility and are easily worked and conserved. Most of them are suited to intensive use, and under good management high-crop yields are obtained.

The Emory soil is a well-drained fertile soil with a brown surface soil and a yellowish-brown subsoil. The Greendale soils are also well drained, but they have a gray or light grayish-brown surface soil and yellow or brownish-yellow subsoil. Some angular chert fragments are on the surface and in the soil. The Ooltewah soil is intermediately drained. The surface layer is light brown or grayish brown and the subsoil mottled gray. The poorly drained Guthrie soil is mottled gray throughout the profile.

SOILS OF THE COLLUVIAL LANDS DERIVED CHIEFLY FROM MATERIALS WASHED FROM UPLANDS UNDERLAIN BY SANDSTONE AND SHALE WITH SOME LIMESTONE INFLUENCE

Soils of the colluvial lands derived chiefly from materials washed from uplands underlain by sandstone and shale with some limestone influence are of the Caylor, Hayter, Allen, Jefferson, and Leadvale series. These soils are chiefly in the limestone and shale valleys, but part of the Jefferson soils are in the creek valleys of Cumberland Mountain. All of them are on foot slopes and benches in the valleys. Their parent materials are soil materials and rock fragments that have washed or rolled from the immediately adjoining uplands to their present positions. In general these soils are older and have more distinctly developed profiles than do the soils derived from limestone colluvium. Their total acreage is small, but agriculturally they are very important because of medium to high fertility and good workability and conservability. They are generally suited to growing a wide variety of crops, and under good management high yields are obtained.

The Caylor soils have developed from colluvial materials washed from uplands underlain by sandstone, shale, and limestone. The surface soil is brown silt loam and the subsoil yellowish-brown silty clay loam. The Allen soil is derived from similar materials, but the proportion of limestone materials is less and the soil is older and more leached. It is lighter in texture and has a grayish-brown to brown surface soil and a yellowish-red to red subsoil. The Leadvale soils are derived from almost entirely acid shales. They

have a light grayish-brown to grayish-yellow surface soil, a yellow subsoil, and a hardpan at depths of 2 to 3 feet. The Jefferson soils are derived from acid sandstone materials and have a stony, gray or yellowish-gray surface soil and a stony brownish-yellow subsoil.

SOILS OF THE STREAM TERRACES DERIVED FROM OLD ALLUVIUM CHIEFLY FROM LIMESTONE MATERIAL

The soils of the stream terraces derived from old alluvium chiefly from limestone material are of the Etowah, Taft, and Robertsville series. They are along the small streams in the limestone valleys on terrace benches above present stream overflow and have developed from old stream alluvium that was washed largely from uplands underlain by limestones. The soils of the group differ in their use suitability and management requirements, but they are at least fairly well suited to growing crops with the exception of the Robertsville soil, which is suited to pasture. Because of their small extent, however, these soils are of relatively little agricultural importance.

The Etowah soil is on gently sloping to sloping well-drained terraces. It has a grayish-brown or light-brown surface soil and a comparatively heavy brownish-red subsoil. The Taft soil is on nearly level imperfectly drained low terraces and has a light-gray surface soil, a grayish-yellow to yellow subsoil, and a hardpan layer. The Robertsville soil is closely associated with the Taft soil but differs in being poorly drained and mottled gray.

SOILS OF THE STREAM TERRACES DERIVED FROM OLD ALLUVIUM CHIEFLY FROM ACID SANDSTONE AND SHALE MATERIALS

The soils of the stream terraces derived from old alluvium chiefly from acid sandstone and shale materials consist of the Waynesboro, Holston, Monongahela, Tyler, and Sequatchie series. These soils are on terraces above the level of present overflow, and their parent materials are derived from old stream alluvium that has washed largely from uplands underlain by acid sandstone and shale. The aggregate acreage is small; but the soils are of considerable agricultural importance—with the exception of the Tyler series—because they are at least fairly well suited to growing crops and are in parts of the county where only a small acreage of soils is suited to cropland. In general, they are used rather intensively and are managed with little regard for improvement or conservation.

The Waynesboro, Holston, Monongahela, and Tyler series are a catena of old terrace soils of which the Waynesboro is the best drained member and Tyler the poorest. The well-drained Waynesboro is on old, sloping high terraces and is rather strongly leached and well oxidized. The surface soil is grayish-brown or light-brown fine sandy loam and the subsoil red or yellowish-red fine sandy clay. The Holston soil differs from the Waynesboro in that it is not so well drained and is lighter in color; the surface soil is gray and the subsoil yellow. The imperfectly drained Monongahela soil is on nearly level relief. It has a grayish-brown to gray surface soil, a yellow or brownish-yellow subsoil, and a mottled hardpan layer. The poorly drained Tyler soil is in level or depressed positions. The surface soil is light yellowish gray and the subsoil mottled yellowish gray. The Sequatchie soils are well drained, and parts of them are subject to overflow at infrequent inter-

vals. They have a light-brown or grayish-brown fine sandy loam surface layer and a yellow-brown clayey subsoil.

SOILS OF THE BOTTOM LANDS DERIVED FROM ALLUVIUM WASHED CHIEFLY FROM LIMESTONE MATERIAL

Soils of the bottom lands derived from alluvium washed chiefly from limestone material consist of the Roane, Lindside, Melvin, and Dunning series. They are on first bottoms along small streams, and their parent materials are derived from alluvium washed largely from uplands underlain by limestone and dolomite. Although drainage is moderate to very slow the soils are at least moderately fertile. Because of their small extent and the limited use suitability of a large part they are of relatively little importance.

The Roane soil is a well-drained brown soil derived from parent material washed largely from uplands underlain by cherty dolomite. A cemented cherty layer is at variable depths. The imperfectly drained Lindside soil has a brown surface layer and a mottled gray subsoil, whereas the poorly drained Melvin soil is mottled gray in both the surface soil and subsoil. Both of these soils are derived from mixed limestone and dolomite materials. The Dunning soil, derived from fine-textured alluvium from limestone, has a thin heavy nearly black surface layer and a fine-textured mottled gray subsoil.

SOILS OF THE BOTTOM LANDS DERIVED FROM ALLUVIUM WASHED CHIEFLY FROM SANDSTONE AND SHALE MATERIALS

The soils of the bottom lands derived from alluvium washed chiefly from sandstone and shale materials consist of the Pope, Philo, and Atkins series. They form a catena of soils developed from sandstone and shale alluvium; the Pope soil being well drained, the Philo imperfectly drained, and the Atkins poorly drained. As a group, they are less productive than comparable soils derived from limestone alluvium, but with the exception of the Atkins soils they are at least fairly well suited to growing crops. They are relatively much more important to the agriculture of the county, however, partly because of their larger acreage but chiefly because they are in parts of the county where the land suited to crops is of very small extent.

The well-drained Pope soil has a grayish-brown sandy surface layer and a yellow or brownish-yellow subsoil. The parent material is washed chiefly from sandstone. The Philo soils, derived from parent material of both sandstone and shale origin, are imperfectly drained and have a grayish-brown fine sandy loam or silt loam surface soil and a mottled gray subsoil. The Atkins soil has similar parent material but differs from the Philo soils in being poorly drained and mottled throughout the profile.

MISCELLANEOUS LAND TYPES

Areas of land on which no true soils are delineated are grouped as miscellaneous land types. Eleven miscellaneous land types are mapped in this county: Alluvial soils, undifferentiated; Limestone rockland (rolling); Limestone rockland (rough); Mine dumps; Rolling stony land (Talbot soil material); Rough gullied land (Montevallo soil material); Rough gullied land (Talbot soil material); Rough stony land (Muskingum soil material); Rough stony land (Talbot soil

material); Smooth stony land (Talbot soil material); and Stony colluvium (Muskingum soil material). Conditions for plant growth are so unfavorable on all these areas that they are not suited to crops under present conditions, and only Smooth stony land (Talbot soil material) and Rolling stony land (Talbot soil material) are suited to pasture.

DESCRIPTIONS OF SOIL UNITS

Thirty-nine soil types, 36 phases, and 1 complex are here described in detail and their agricultural relations discussed. In addition 11 miscellaneous land types are listed: Alluvial soils undifferentiated, Limestone rockland (rolling), Limestone rockland (rough), Mine dumps, Rolling stony land (Talbot soil material), Rough gullied land (Montevallo soil material), Rough gullied land (Talbot soil material), Rough stony land (Muskingum soil material), Rough stony land (Talbot soil material), Smooth stony land (Talbot soil material), and Stony colluvium (Muskingum soil material). Their location and distribution in the county are shown on the accompanying soil map, and their acreage and proportionate extent in table 5.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Claiborne County, Tenn.*

Soil	Acres	Per- cent	Soil	Acres	Per- cent
Allen loam	299	0.1	Dunning silty clay loam	160	.1
Alluvial soils, undifferentiated	629	.2	Emory silt loam	772	.3
Armuchee silt loam	859	.3	Etowah silty clay loam, eroded phase	176	.1
Steep phase	6,967	2.5	Fullerton cherty loam	2,170	.8
Atkins silt loam	538	.2	Hilly phase	6,514	2.3
Bolton silt loam	1,604	.6	Steep phase	10,803	3.9
Rolling phase	1,060	.4	Fullerton cherty silt loam	5,842	2.1
Steep phase	1,549	.6	Hilly phase	16,639	6.0
Caylor silt loam	1,943	.7	Steep phase	20,265	7.3
Gently sloping phase	844	.3	Fullerton loam	1,008	.4
Caylor stony silt loam	84	(¹)	Hilly phase	1,210	.4
Claiborne silt loam	7,113	2.5	Steep phase	437	.2
Rolling phase	2,864	1.0	Fullerton silt loam	2,317	.8
Steep phase	8,636	3.1	Hilly phase	3,869	1.4
Clarksville cherty loam: ²			Steep phase	1,124	.4
Hilly phase	1,955	.7	Greendale silt loam	1,216	.4
Steep phase	4,328	1.5	Sloping phase	2,212	.8
Clarksville cherty silt loam	1,647	.6	Guthrie silt loam	68	(¹)
Hilly phase	5,227	1.9	Hartsells stony fine sandy loam	548	.2
Steep phase	11,819	4.2	Holston fine sandy loam	277	.1
Clarksville loam	179	.1	Jefferson stony fine sandy loam	627	.2
Colbert silty clay loam, eroded phase	93	(¹)	Sloping phase	1,653	.6
Dewey cherty silt loam	728	.3	Leadvale silt loam	460	.2
Dewey silt loam	168	.1	Sloping phase	713	.3
Dewey silty clay loam:			Lehew fine sandy loam	9,470	3.4
Eroded phase	1,175	.4	Hilly phase	319	.1
Eroded hilly phase	671	.2			
Eroded steep phase	203	.1			

¹ Less than 0.1 percent.

² Where data are given for phases only the normal type is not mapped in the county.

TABLE 5.—*Acreage and proportionate extent of the soils mapped in Claiborne County, Tenn.—Continued*

Soil	Acres	Percent	Soil	Acres	Percent
Limestone rockland:			Rough stony land:		
Rolling-----	5, 287	1. 9	Muskingum soil material-----	13, 881	5. 0
Rough-----	2, 483	. 9	Talbot soil material-----	14, 723	5. 3
Lindside silt loam-----	839	. 3	Sequatchie fine sandy loam-----	1, 302	. 5
Melvin silt loam-----	508	. 2	Sloping phase-----	625	. 2
Mine dumps-----	92	(¹)	Sequoia silty clay loam, eroded phase-----	195	. 1
Monongahela silt loam-----	151	. 1	Smooth stony land (Talbot soil material)-----	641	. 2
Montevallo shaly silt loam-----	1, 726	. 6	Stony colluvium (Muskingum soil material)-----	494	. 2
Hilly phase-----	1, 272	. 5	Taft silt loam-----	779	. 3
Muskingum stony fine sandy loam-----	47, 609	17. 1	Talbot-Hayter silt loams-----	706	. 3
Deep phase-----	4, 103	1. 5	Steep phases-----	439	. 2
Ooltawah silt loam-----	523	. 2	Talbot silt loam-----	629	. 2
Philo fine sandy loam-----	2, 137	. 8	Hilly phase-----	1, 825	. 7
Philo stony fine sandy loam-----	791	. 3	Steep phase-----	310	. 1
Popc fine sandy loam-----	607	. 2	Talbot silty clay loam, eroded phase-----	3, 166	1. 1
Roane silt loam-----	969	. 3	Tyler silt loam-----	115	(¹)
Robertsville clay loam-----	107	(¹)	Waynesboro fine sandy loam, eroded phase-----	190	. 1
Rolling stony land (Talbot soil material)-----	13, 971	5. 0	Total-----	277, 963	100. 0
Rough gullied land:					
Montevallo soil material-----	391	. 1			
Talbot soil material-----	326	. 1			

See footnote, p. 36.

ALLEN SERIES

The soil of the Allen series is on low rolling fans and benches in limestone valleys at the foot of mountain slopes. As mapped in this county, the Allen soil is older and more strongly leached than the associated Caylor and Jefferson soils. The texture is generally lighter than that of the Caylor soils but heavier than the Jefferson. Fertility is medium to low, and the reaction is medium to strongly acid.

The grayish-brown to brown loam surface layer is underlain by a yellowish-red to red fine sandy clay or sandy clay loam subsoil. The substratum is a mixture of red sandy clay soil material and sandstone and shale rock fragments. It varies in thickness but is generally thicker than the comparable layer in the Caylor soils. High-grade limestone bedrock is many feet below the surface.

Allen loam, the only type mapped, is a complex pattern associated with the Caylor and Jefferson soils on the colluvial lands and with the Dewey and Talbot on the uplands.

Allen loam.—A moderately fertile, moderately eroded, acid soil on well-drained terracelike fans and benches in the limestone valleys. Its parent materials are colluvium or local alluvium—chiefly from sandstone and shale with some limestone influence—that has rolled or washed from the slopes of nearby mountains. The soil is moderately

eroded, is practically stone-free, and has rolling slopes of 8 to 15 percent. Both internal and surface drainage are moderate. Native vegetation was a mixed forest of oak, hickory, dogwood, and possibly shortleaf pine.

Most of the 299 acres mapped is in the southwestern half of Powell Valley in small or medium-sized areas, but a few small areas are in the valley of Big Sycamore Creek in the vicinity of Howard Quarter.

The profile is well developed. To a depth of 6 to 8 inches the soil is grayish-brown to brown mellow friable loam with a fine granular structure. Organic-matter content is relatively low, and the reaction is medium to strongly acid. The soil is permeable to air, roots, and moisture, but moisture absorption and retention are less than in the associated Caylor soils, and crops may be injured by extended periods of drought. Tillage can be accomplished over a moderate range of moisture conditions, and good tilth is fairly easily maintained. In the more severely eroded places, where much of the surface layer is missing and the heavier subsoil is turned by the plow, the content of fertility and humus is lower and good tilth and moisture conditions are more difficult to maintain. Fragments of sandstone are on the surface and in the soil in some places. At a depth of 8 to 10 inches the upper yellowish-red fine sandy clay subsoil is underlain by a bright-red moderately friable fine sandy clay or sandy clay loam with a well-developed nut structure. The total thickness of these two layers is about 30 inches, and they are underlain by mottled red soil material and fragments of sandstone and shale. This layer is several feet thick in most places and is underlain by high-grade limestone.

Several variations are mapped. About one-fourth of the soil has slopes of less than 8 percent, and the surface soil texture varies from fine sandy loam to silt loam with corresponding variations in the subsoil. Considerable limestone material is in the heavier textured part of the soil, whereas the coarser textured part is derived almost entirely from sandstone. On a few of the steeper slopes in Powell Valley the original surface soil has been lost by accelerated erosion and the upper subsoil is now at the surface. The depth of the colluvial deposit from which the soil is developed ranges from as little as 3 feet to more than 10. These variations may cause local differences in the management requirements of the soil but in general are not significant.

Use and management.—Much of Allen loam is used rather intensively and, as with other soils in the limestone valleys, management practices do not compensate for soil deficiencies. Practically all the soil is cleared and used mainly for corn, lespedeza hay, and small grains; but small acreages are used for tobacco and pasture. Most farmers use a rotation of corn or tobacco, small grain, and hay—chiefly lespedeza, but in some places red clover. A few of the more severely eroded areas are in permanent pastures of lespedeza and wild grasses. As with most other soils, burley tobacco is heavily fertilized with a high-grade complete commercial mixture; whereas corn and small grains receive small applications of low-grade material, and hay and pasture crops are not fertilized. A small part of the soil is limed at fairly regular intervals. No special practices for preventing erosion and conserving soil moisture are used. Under prevailing

management practices, corn yields about 28 bushels to the acre; wheat, 15 bushels; tobacco, 1,100 pounds; timothy and clover hay, 1½ tons; and lespedeza, 1¼ tons.

Requirements for good management center on proper choice and rotation of crops, use of lime and fertilizer, and control of runoff. A rotation including a row crop one in 3 or 4 years is well suited to the soil. Legumes, including red clover, crimson clover, and alfalfa, do well and should have an important place in the rotation; they are effective in increasing humus and nitrogen content and in improving tilth and moisture conditions. Small to moderate quantities of lime at moderately frequent intervals, however, are necessary to insure success with legumes. Requirements for fertilizers are similar to those of the associated uplands and colluvial soils. Tobacco requires moderate to large quantities of high-grade complete fertilizer high in phosphorus and potash. Small grains and corn need a complete fertilizer with medium quantities of nitrogen and potash and much phosphorus. Legumes require relatively large quantities of potash and phosphorus but no nitrogen. Contour tillage is a good practice, and properly constructed broad-base terraces are helpful in the prevention of erosion and conservation of the soil moisture in some situations. Under good management, corn yields about 43 bushels an acre; wheat, 20 bushels; lespedeza, 1½ tons; and burley tobacco, 1,275 pounds.

ALLUVIAL SOILS, UNDIFFERENTIATED

Alluvial soils, undifferentiated, is a complex of imperfectly and poorly drained soils on the narrow bottom lands of small streams in all parts of the Great Valley section of the county. The parent material of young stream alluvium and some colluvium is from uplands underlain by limestone, cherty dolomite, acid shale, and sandstone. The original forest cover was of hardwood. Slopes are generally less than 2 percent, but locally may be as much as 5 percent. Both internal and external drainage are slow to moderate. An aggregate area of 629 acres is mapped. On the cherty ridges, Clarksville and Fullerton soils are on the adjoining uplands; on the shale ridges are Montevallo soils; and in the limestone valleys are various soils including the Dewey and Talbott.

Where the land type is mapped in the cherty ridge sections, it consists chiefly of an intricate pattern of cherty Melvin and Lindsdale soils with small spots of Greendale and Roane soils. In the limestone valley and in the shale ridges it is a complex pattern of poorly and imperfectly drained alluvial and colluvial soils that do not fit well into any other classification unit. The surface soil is brownish or grayish silt loam or fine sandy loam, and the subsoil is gray in most places and varies widely in texture. In general, reaction is strongly acid, and organic-matter content is low. Moisture conditions are poor to fair. Chert, limestone, sandstone, and shale fragments are on the surface and in the soil in many places. Variations include differences in color, texture, drainage, stoniness, and sources of parent material.

Use of management.—The present use and management of Alluvial soils, undifferentiated, are variable. A small part is in forest, and most of the cleared area in the cherty ridge sections is used for pasture; in other places various crops may be grown. No special management

practices are ordinarily used. Pastures are poor to fair both as to quality and quantity, and crop yields are low.

The use suitability and requirements for good management vary from place to place. The small better drained parts of any delineated area may be useful as cropland, but local farm conditions determine whether this is profitable. Where the soil is used for crops, management practices for Lindside silt loam are applicable. Much of the land type is suited only to pasture, however, and management practices are similar to those for Melvin silt loam.

ARMUCHEE SERIES

The Armuchee soils are in broad bands on belts of cone-shaped knobs on the upper slopes of the mountain ridges bordering limestone valleys (pl. 6, *B*). Their parent material was weathered from interbedded limestone and shale, and they were developed under a hardwood forest. Slopes are hilly on about 10 percent of the area and the rest is on steep slopes. Practically all the soil is eroded to some extent. The surface soil is a friable yellowish-brown silt loam and the subsoil brownish-red or yellowish-red shaly silty clay. At depths of 2 to 3 feet is calcareous shale bedrock containing thin beds of gray limestone.

Slopes are so strong and bedrock is so shallow that these soils are not suited to crops, but they are moderately fertile, and under good management are well suited to pasture. Pasture management requirements are concerned chiefly with proper choice of pasture plants and correct use of soil amendments. These soils are probably more productive than Armuchee soils farther south in Tennessee, but they are less productive than the Westmoreland soils of southwestern Virginia, which they resemble in some respects. Two types, the silt loam and its steep phase, are mapped.

Armuchee silt loam.—Occurring on slopes of 15 to 30 percent on valley mountain ridges, this soil has rapid surface drainage and moderate internal drainage. It was developed from parent material weathered from interbedded limestone and shale of the Reedsville formation or shaly limestone of the Conasauga group under a mixed hardwood forest of oak, hickory, dogwood, walnut, beech, and maple. The total of 859 acres mapped occurs on small irregularly shaped areas on the upper slopes on the southeast side of Poor Valley Ridge and on the northwest sides of Powell and Lone Mountains and Wallen Ridge associated with the steep phase. Small areas also are in Caney Ridge associated with the Montevallo soils.

The profile is similar to that of the steep phase, but more of the original surface of this soil has been lost by accelerated erosion because of its more intensive use. To a depth of 10 to 12 inches the surface is a light-brown or yellowish-brown friable, heavy silt loam with a crumb structure. It contains small partly weathered shale fragments. Under grass sod the upper 1 or 2 inches may contain a considerable quantity of organic matter. Reaction is strongly acid. The soil is moderately absorptive and retentive of moisture. Sandstone fragments that have rolled down from the ridge crests may be on the surface in some places. This layer is underlain by a horizon composed of alternate bands of partly weathered green or yellow shale

and heavy, sticky, plastic brownish-red or yellowish-red silty clay. Green or yellow calcareous shale bedrock is interbedded with thin layers and lenses of limestone at depths of 2 to 3 feet.

As mapped, this soil varies considerably as to loss of the original surface layer through erosion. Where it has been used for crops, the original surface soil is almost completely missing; but where it has been principally in pasture, very little is gone. The proportion of limestone material in the soil varies from 25 to about 75 percent. This soil is more fertile than the Armuchee soils farther south in Tennessee; in fertility it more nearly resembles the Westmoreland soils of southwestern Virginia.

Use and management.—In the past Armuchee silt loam was improperly used, but at present its use is fairly well adjusted to its properties, although management practices generally are not designed to compensate for the soil deficiencies. Practically all the soil is cleared. Much of the land was once used for corn and other crops, but nearly all of it is now used for pasture. In a few places where it is used for corn, the yields are generally so low under common management that they are not profitable. Present pastures and present yields and management are very similar to those on the steep phase.

Under present conditions this soil is not suited to cropland, because of its eroded condition, strong slopes, and shallowness, but moderate fertility and responsiveness to good management make it well suited to pasture. Management requirements are concerned chiefly with the choice of suitable pasture plants and the correct use of soil amendments.

Armuchee silt loam, steep phase.—Areas of this soil occupy upper slopes of valley mountain ridges on steep cone-shaped knobs. The soil is underlain by interbedded limestone and shale chiefly of the Reedsville formation, by calcareous shale of the Sequatchie formations (9), and by shaly limestone of the Conasauga formation (14). Native vegetation was a mixed hardwood forest of oak, hickory, elm, dogwood, some maple, and walnut. Slopes range from 30 to 60 percent and in places are as steep as 80 percent. Surface drainage is rapid, and internal drainage moderate.

The soil occupies 6,967 acres in broad bands on the upper northwest slopes of Powell and Lone Mountains and Wallen Ridge and on the southeast slopes of Poor Valley Ridge. Lebew soils are on the mountain crests above this soil; whereas Rough stony land (Talbot soil material) and the hilly and steep phases of Talbot soils and Talbot-Hayter silt loams are on the lower slopes. On the steep knobs on the south side of Caney Valley long narrow strips are associated with Montevallo soils, and on the slopes along the south end of Straight Creek in the southern part of the county irregularly shaped areas are associated with Dewey, Fullerton, and Montevallo soils.

This soil does not have a well-developed profile. Under a well-established grass sod the upper few inches consists of grayish-brown friable silt loam, heavily matted with grass roots and containing well-humified organic matter. At a depth of 12 to 15 inches it is underlain by light-brown friable heavy silt loam of granular structure and containing small fragments of partly weathered shale. The reaction

is strongly acid. The soil is permeable to air and plant roots and is moderately retentive of moisture. This layer is underlain by a horizon 12 to 24 inches thick of alternate bands of partly weathered blocky green or yellow shale and heavy, sticky, plastic brownish-red silty clay. Beneath this the bedrock is green or yellow calcareous blocky shale, containing thin lenses and layers of blue or gray limestone. Narrow limestone ledges outcrop on the surface in many places.

Variations occur in quantity of surface soil, thickness of layers, red silty clay content in the substratum, quantity of limestone in the underlying rock—25 to 75 percent—and steepness of slope.

Use and management.—The steep phase of Armuchee silt loam is probably more uniform in use and management than any other agricultural soil in the county. The present use of the soil is fairly well adjusted to its physical suitability, but management practices are not designed to conserve it or to correct its deficiencies. At present about 20 percent of the area is in forest and practically all the rest is used for pasture, although a small acreage may be in corn. The pasture consists of a mixture of wild and tame grasses and legumes, including broomsedge, bluegrass, common lespedeza, and white clover. Very few farmers use either lime or fertilizer on the soil. Most pastures are large and in general are not overgrazed; in fact, many farmers do not graze enough stock to use all the available forage. Young stock makes good growth on these pastures, but generally the grasses are not sufficiently nutritious to fatten cattle.

Because of steep slopes and shallowness this phase is not suited to growing crops, but it is well suited to pasture because of its moderate fertility, response to management, and its available water supply for livestock. Kentucky bluegrass and white clover are very well suited to the soil, but many other plants, including redbtop, orchard grass lespedeza, and various clovers, may be expected to do well. Moderate quantities of lime at frequent intervals are required, and phosphorus is needed, but potash is unnecessary. Nitrogen may be required to establish grass sods; but if legumes are included in the pasture mixture, continued use of fertilizers containing nitrogen should not be necessary.

Grazing should be controlled to prevent injury to the pasture stand and to prevent erosion during periods of adverse moisture conditions. It is also effective in controlling weeds, but occasional pasture clipping for weed eradication may be necessary. Shading by widely spaced walnut or black locust trees may be beneficial. When sods are well established, properly fertilized, and carefully grazed, other practices for preventing erosion and conserving moisture are not needed. Under such management, pastures of excellent quality and high carrying capacity are obtained.

Furnishing water to grazing animals is not ordinarily a serious problem, inasmuch as small springs are in nearly all the small intermittent streams that dissect the mountain slopes. In some places where the soil is on narrow very steep slopes at the bottom of ridges and contains a low proportion of limestone material, conditions are unfavorable for pasture because of poor moisture relations, low fertility, and difficult grazing of steep slopes. Many of these areas are now in forest and should remain so, and cleared areas should be reforested with suitable kinds of trees.

ATKINS SERIES

The soil of the Atkins series is on level poorly drained bottom lands along the streams in Cumberland Mountain and in the shale valleys. It is closely associated with the Pope and Philo soils but is not so well drained. It differs from the Melvin soil chiefly in being underlain by young stream alluvium washed mainly from acid sandstone and shale rather than from limestone.

The gray silt loam surface layer is underlain by a gray or bluish-gray silt loam to silty clay loam subsoil. The underlying alluvium is derived from acid sedimentary rocks and consists of mottled gray sand, silt, and clay. It is many feet thick and is underlain by sandstone bedrock in most places. This strongly acid soil varies somewhat in texture and stoniness. One type, the silt loam, is mapped.

Atkins silt loam.—Occurring on level or slightly depressed stream bottom lands, this soil is subject to frequent overflow. It is underlain by young stream alluvium—including beds of sand, silt, clay, and some gravel—washed from uplands underlain by acid sandstone and shale. The soil was developed under a mixed forest of sycamore, sweetgum, black tupelo (blackgum) elm, water oak, willow oak, and willow, with cattail, sweetflag, and various sedges, and wild grasses in the wettest places. Slopes are 1 to 2 percent. Both surface and internal drainage are very slow. A total of 538 acres is mapped. Small areas are on Cumberland Mountain, chiefly near the heads of streams that rise on the few flat-topped mountains, but also along the large streams. The soil is associated with Pope and Philo soils on the bottom lands, with Jefferson soils on the adjoining colluvial lands, and with Muskingum soils in the nearby uplands. Areas also are along Gap Creek in the Great Valley part of the county and along Big Sycamore Creek.

Although the profile of this soil is similar to that of Melvin silt loam, the two soils differ in that the Atkins soil is derived from materials from acid rocks, is generally more strongly acid, and is lower in inherent fertility. The surface few inches of gray silt loam is mottled with yellow and brown and is strongly to very strongly acid in reaction. It is low in humus but contains fragments of partly decomposed plants. Much of the year the soil is saturated with water, and, in places, water stands for long periods after rains. The gray or bluish-gray silt loam to silty clay loam subsoil is mottled with yellow and brown. This layer is saturated with water most of the time. It is 1 to 3 feet thick and is underlain by gray stream alluvium consisting chiefly of silt and clay containing some beds of sand and gravel.

Variations are chiefly in texture. Most of the soil mapped along the smaller streams in the mountains and along Gap Creek has a fine sandy loam surface soil, a sandy clay subsoil, and the underlying alluvium is chiefly sandy material. Drainage is somewhat better on these sandy areas of the soil. Much of the soil on Cumberland Mountain has small or moderate quantities of sandstone fragments on the surface and in the soil.

Use and management.—At present practically all of Atkins silt loam is cleared. A small acreage is used for growing corn, but most of it is in poor quality pasture, consisting chiefly of native wild grasses and

sedges with cattails and willows in the wettest places. No soil amendments are used, and no practices for improving drainage are followed. As a result, corn yields are very low, usually less than 10 bushels to the acre, and the carrying capacity of pastures is small because of the large proportion of unpalatable plants in the mixture.

Management requirements vary from place to place depending upon the frequency of overflow and drainage conditions and the feasibility of improving them. Where the soil is subject to very frequent overflow and where it is very poorly drained and drainage cannot be improved at moderate cost, it is best used for forestry or, if necessary, allowed to remain in low-grade pasture of native plants. Where the soil is better drained or where drainage can be improved by the use of open ditches, pastures of legumes and tame grasses can be obtained. Management requirements for such pastures should be about the same as those for Melvin silt loam.

BOLTON SERIES

The Bolton series includes the most desirable agricultural soils of the cherty ridges. These soils occur on the upper slopes of the ridges and are apparently underlain by nearly chert-free sandy dolomites. They were formed under a mixed hardwood forest in association with the Claiborne, Fullerton, and Clarksville soils.

Although the soils are throughout the cherty ridge section in the central part of the county, the largest proportionate acreage is west of New Tazewell between State Highway No. 33 and the Powell River. About 25 percent of the soils have rolling relief, 38 percent are hilly, and 37 percent steep. They are practically free of stone and chert, and practically none of them is severely eroded.

The dark reddish-brown friable silt loam surface layer is about 12 inches thick. The subsoil is dark-red friable silty clay loam with a weakly developed fine nut structure. This layer is about 4 or 5 feet thick and is underlain by red silty clay with a well-developed nut structure. Some faint mottlings and a small quantity of fine chert fragments may be present. Bedrock is at a depth of 30 feet or more below the surface.

On rolling and hilly relief the Bolton soils are suited to growing tilled crops, whereas the steep areas are best used for pasture. Management requirements are less exacting than for other soils of the cherty ridges; but special practices for furnishing lime, phosphorus, and possibly potash are needed, and moderate measures for runoff and erosion control are required, especially on the stronger slopes. Three types, the silt loam and its rolling and steep phases, are mapped.

Bolton silt loam.—This chert-free soil is on the upper slopes of cherty ridges underlain by sandy dolomite. Slopes range from 15 to 30 percent, and both internal and external drainage are moderate. Although locally called "brown chestnut land," this soil was developed under a mixed hardwood forest of maple, beech, tuliptree (yellowpoplar), and chestnut. Second-growth forest is a mixed stand of yellowpoplar and shortleaf pine in most places.

The largest proportionate acreages are in the vicinities of New Tazewell, Goins, and Clouds on the cherty ridges, but areas are widely distributed over all parts of the cherty ridge section of the county.

These areas are irregular in shape, of variable size, and associated most closely with other types of Bolton soils and with soils of the Claiborne series. Types or phases of Fullerton and Clarksville soils are on the rolling ridge crests above this soil in many places. The total area is 1,604 acres.

Where uneroded, the dark reddish-brown mellow friable silt loam surface soil is about 12 inches thick. In most places enough of the surface layer remains so that the subsoil is not turned by plowing. The upper few inches are well supplied with humus. Recently cleared areas are only slightly acid, but where crops have been grown for several years the reaction is medium or strongly acid. Good tilth is easily maintained—most tillage operations are accomplished with ease and over a fairly wide range of moisture conditions. Some farmers, however, report that the furrow slice does not scour from the plow moldboard, and the local name of "push soil" is given. By using a plow with a correctly designed moldboard this difficulty can probably be eliminated. Another local name, "puffy land," indicates that farmers recognize its friable consistence. The soil is absorptive of water, and surface runoff is probably less than for other soils of the county of similar slopes. Soil, air, and water circulate freely; and moisture conditions for crop growth are excellent. Some farmers report frost heaving of hay and small grains in winter months. In some places a small quantity of fine chert fragments may be on the surface and in the soil.

In most places a yellowish-brown friable heavy silt loam transitional layer 6 or 8 inches thick is between the surface soil and the subsoil. The subsoil is dark-red silty clay loam. It is friable and easily crushed to a soft granular mass. Reaction is strongly acid. A large quantity of small spherical dark-brown concretions and a small quantity of small angular weathered chert fragments are present. This layer is 4 to 5 feet thick and is underlain by red silty clay with a well-developed nut structure. This substratum is faintly mottled with gray, yellow, and brown in some places and is moderately friable when moist but sticky and plastic when wet. A small or moderate quantity of angular chert fragments is present. Dolomite bedrock is at depths of 30 to 50 feet or more.

Included variations are those due chiefly to color differences of the surface soil. In the northeastern part of the county the surface soil is somewhat lighter in color than is normal, being brown or yellowish brown rather than reddish brown. In many places, where the soil is immediately adjacent to areas of Claiborne soils, the boundaries between the soils are not distinct and the soil near the edges of a delineated area of Bolton silt loam may be more like the Claiborne soil than normal Bolton silt loam.

Use and management.—Bolton silt loam is not exacting in its requirements for good use and management, but in general, present practices are not very well adjusted to the physical character of the soil. Practically all the soil has been cleared and cultivated, but about 10 percent has been abandoned to forest because of depletion of fertility and soil material by continued cropping and erosion. About 30 percent is used for growing corn, 15 percent for small grains, 10 percent for tobacco and vegetable crops, and 35 percent for hay and pasture.

Few farmers use systematic rotations, and row crops may be grown for several years in succession followed by hay crops or rest periods. Corn and small grains generally receive small applications of 0-10-4 fertilizer or superphosphate and, where available, barnyard manure. Tobacco and vegetable crops are treated with heavy applications of barnyard manure and large quantities of complete commercial fertilizers as a 3-8-6 mixture. Very little of this soil receives any lime. Special methods for the control of runoff, as terracing, strip cropping, or the use of winter cover crops, are not ordinarily practiced, but most tillage operations are on the contour. Under common management practices, acre yields of about 25 bushels of corn, 900 pounds of burley tobacco, 10 bushels of wheat, 1 ton of lespedeza hay, 1 ton of mixed hay, and 2 tons of alfalfa may be expected.

The chief requirements for good management are concerned with supplying lime, phosphorus, and potash; maintaining the supply of organic matter; and preventing erosion. If other management requirements are met, the soil can be conserved under a rotation including a row crop once in 4 or 5 years. Legumes as alfalfa and clover are effective in maintaining the humus supply, and sods are formed that are beneficial in preventing erosion. Lime, phosphorus, and potash are needed to insure good stands of legumes that should remain on the soil for much of the rotation.

Corn, tobacco, and vegetables do well if they are properly fertilized. Tobacco and vegetables require heavy applications of complete fertilizers containing nitrogen, phosphorus, and potash, but corn following legumes may need only phosphorus and light applications of potash. Rotations should be planned so that lime is not applied immediately prior to planting tobacco or potatoes. Row crops can well be seeded to winter cover crops as soon as they are harvested in order to prevent erosion in winter. Wheat and other small grains are useful in this respect, and good yields may be expected if moderate applications of fertilizers containing nitrogen, phosphorus, and potash are used. Stands of small grain, however, are occasionally injured by frost heaving in winter. The effectiveness of terracing as a means of controlling erosion is doubtful, but strip cropping or contour tillage may be used on the longer slopes. Check dams can be used to control the larger gullies.

Under good management, acre yields of 35 bushels of corn, 15 bushels of wheat, 1.3 tons of lespedeza, and 1,125 pounds of burley tobacco may be expected.

Bolton silt loam, rolling phase.—This phase is on the rolling crests of ridges underlain by slightly cherty sandy dolomite of the Knox formation. Slopes are from 8 to 15 percent. Most of the soil is in long narrow strips along the ridge crests, in association with the other Bolton soils and with the Claiborne, Fullerton, and Clarksville soils. The total area of 1,060 acres is widely distributed throughout the cherty ridge section, but the largest proportionate acreage is northwest of New Tazewell. Both internal and external drainage are moderate. Native vegetation was a mixed hardwood forest of maple, beech, chestnut, oak, and yellowpoplar.

The profile is essentially the same as that of the normal phase, but the surface soil may be thicker. To a depth of 8 to 12 inches the

surface is dark reddish-brown mellow friable heavy silt loam with a fine crumb structure. The organic-matter content is high as compared with other upland soils of the county. Reaction is medium to strongly acid. The soil is permeable to air, water, and roots, and good tilth is easily maintained. Tillage may be carried on over a wide range of moisture conditions, but the soil fails to scour from the plow mold-board under certain conditions. Moisture conditions for crop growth generally are good, and control of runoff and erosion are accomplished with only a few special practices because of the permeable absorptive qualities of the soil. In many places small fragments of weakly cemented sandstone are on the surface, and angular chert fragments may be in some places. The local names "puffy land," "push land," and "brown chestnut land" indicate that many farmers recognize the more important characteristics of the soil.

A transitional layer of yellowish-brown friable heavy silt loam about 8 inches thick is between the surface soil and the subsoil. The subsoil is a dark-red moderately friable silty clay loam with a weakly developed fine nut structure. It crushes easily to a soft crumblike mass. Reaction is strongly acid. Many small spherical dark-brown concretions and a small quantity of fine chert fragments are present. This layer is about 5 feet thick and is underlain by a faintly mottled bright-red silty clay with a well-developed nut structure. Some angular chert fragments occur. Dolomite bedrock is at depths of 30 to 50 feet.

The chief variation is in the color of the surface soil. In the north-eastern part of the county where much of the soil mapped in this separation has a brown or yellowish-brown surface soil, the subsoil is generally a little lighter in color than normal. As the soil is closely associated with soils of the Claiborne series, in some places the boundary between the two soils is not distinct and small areas with profiles more like those of the Claiborne soils may be included.

Use and management.—Because it is a productive soil associated with large unproductive areas, Bolton silt loam, rolling phase, is used intensively, and management practices are only fairly well adjusted to the physical character of the soil. It is physically good to excellent cropland, and practically all of it is cleared and cultivated. Estimates indicate that about 35 percent is used for growing corn, 10 percent for wheat, 35 percent for hay—principally lespedeza, and 20 percent for tobacco and vegetables.

A few farmers use a rotation of a row crop, small grain, and hay, but definite cropping systems are not used on much of the soil. Tobacco, corn, or vegetables are grown for several successive years followed by lespedeza. Corn and small grains receive small applications of 0-10-4 fertilizer and some barnyard manure if it is available. Vegetables and tobacco are fertilized heavily with 3-8-6 or a similar mixture and in many places also receive applications of barnyard manure. Hay crops ordinarily receive no amendments. Very little of the soil is ever limed. Usually tillage is roughly on the contour, but other special practices for controlling runoff and erosion are not ordinarily used. Under prevailing management average yields of about 30 bushels of corn, 13 bushels of wheat, 1,100 pounds of burley tobacco, 1½ tons of mixed hay, 1¼ tons of lespedeza, and 2¾ tons of alfalfa to the acre may be expected.

Management requirements are not exacting and are concerned chiefly with supplying lime and mineral plant nutrients, maintaining the supply of organic matter, and preventing erosion. They can be accomplished largely through the proper choice and rotation of crops and the use of soil amendments. The soil can be conserved under a rotation including a row crop once in 3 years. A row crop followed by small grain seeded to a legume makes a desirable rotation. As soon as intertilled crops are harvested, a cover-crop small grain or a legume is needed to prevent excessive runoff and erosion in winter. The soil is well suited to growing corn, tobacco, lespedeza, red clover, alfalfa, crimson clover, and small grains. It is especially well suited to vegetables because of the generally prevailing good moisture conditions, good tilth, high humus content, and fertility. A legume for at least a year during each rotation is effective in maintaining the organic-matter content and in supplying nitrogen. Barnyard manure is also effective in this respect and furnishes some potash in addition.

Vegetable crops, burley tobacco, and legumes require liberal applications of fertilizers containing phosphorus and potash. Further increase in yields of vegetables may be obtained by use of nitrogen fertilizers in addition to potash and phosphorus. Corn and small grains need heavy applications of phosphorus and possibly potash, but lespedeza and grass hays probably need little or no fertilization when other crops in the rotation receive heavy applications. Moderate to heavy applications of ground limestone at moderately long intervals are necessary to insure good yields of legumes and will probably result in increased yields of other crops. Contour tillage should be practiced wherever possible; but where crops are properly rotated and properly fertilized, other special practices for preventing erosion are unnecessary. Well-planned, properly constructed, and well-maintained broad-base terraces, however, may be effective on the more severely eroded areas. Under good management yields of about 40 bushels of corn, 18 bushels of wheat, 1,350 pounds of burley tobacco, and 1.5 tons of lespedeza hay to the acre may be expected.

Bolton silt loam, steep phase.—An aggregate area of 1,549 acres of this phase is mapped on steep slopes of cherty ridges underlain by slightly cherty sandy dolomite of the Knox formation. Slopes are from 30 to 60 percent but are mostly less than 40 percent. Internal drainage is moderate, but external drainage is rapid. The soil was developed under a mixed hardwood forest of chestnut, yellowpoplar, beech, maple, and oak. The largest proportionate acreage is in the cherty ridge section southwest of New Tazewell. Much of it is on steep north- and east-facing slopes that surround covelike drain heads, but it is not exclusively in such sites. It is associated with other Bolton, Claiborne, Fullerton, and Clarksville soils, and in many places where it is adjacent to Claiborne silt loam, steep phase, the boundary between the two soils is not distinct.

The profile is similar to that of the normal phase, but more of the surface layer has been lost by erosion. The reddish-brown friable silt loam surface soil is 4 to 8 inches thick. It is medium to strongly acid and is comparatively low in organic matter as compared with other Bolton soils. Good tilth is fairly easily maintained and moisture conditions generally are good, but this phase is less favorable in

these respects than are other Bolton soils. A moderate quantity of chert fragments may be on the surface.

The red moderately friable silty clay loam subsoil contains many small brown concretions and some angular chert fragments. It is about 4 feet thick and is underlain by faintly mottled red silty clay with a nut structure. Bedrock is generally at depths of 20 feet or more but a few surface outcrops are in some places.

Variations included in mapping are those in thickness of soil layers, owing to differences in the amount of erosion, and those in the color of the soil material. In some places the original surface layer is entirely missing and the present surface soil is formed by the upper part of the original subsoil. As with other Bolton soils, in the northeastern part of the county, surface soils are brown or yellowish brown. The boundary between this soil and the Claiborne soils is not everywhere distinct, and some small areas with profiles similar to those of the Claiborne soil are included in this separation.

Use and management.—Bolton silt loam, steep phase, is associated with large areas of relatively unproductive soils in many places. Inasmuch as it is fairly fertile as compared with other soils on steep slopes, it is used largely for purposes for which it is not well suited physically. Management practices are not generally designed to conserve the soil, and, although tillage is on the contour from necessity, no other special practices for controlling runoff and preventing erosion are used. Practically all the soil has been cleared and used for agricultural purposes at one time, but about one-fourth of it has been abandoned and is now covered with second-growth forest of shortleaf pine and yellowpoplar. About 25 percent of the soil that is now cleared is used for growing corn, 50 percent for hay and pasture, and 25 percent is idle.

Definite crop rotations are not followed; corn may be grown for several years in succession followed by mixed hay or pasture of lespedeza, timothy, and redtop. Some fields are allowed to grow up in broomsedge and brush and require grubbing before they can be used for crops. Small quantities of commercial fertilizer are used on corn, but hay crops and pasture are not fertilized. Very little of the soil is ever limed. Under common management practices, yields of about 15 bushels of corn and $\frac{3}{4}$ ton of lespedeza or mixed hay to the acre may be expected.

Although the profile is similar to that of the normal phase, management requirements are different because of the steeper slopes. In addition to furnishing lime and mineral plant nutrients and maintaining the humus supply, this soil requires careful practices for the control of runoff and erosion. Under rotations including row crops the soil cannot be conserved, and it is best used for growing forage crops for hay and pasture. Lespedeza, red clover, timothy, redtop, and orchard grass are well suited to the soil; but alfalfa and bluegrass will do well only on the less eroded sites where soil and moisture conditions are most favorable. Heavy applications of phosphorus are needed by all these crops, and legumes also need potash. Lime is required. These sod-forming crops tend to increase the humus content of the soil, thereby improving tilth and increasing the moisture absorbing properties; and, in addition, the roots are effective in binding the soil

mass. Excessive runoff and erosion are therefore prevented, and where sod crops are grown continuously other erosion control practices are not needed except for the use of check dams to control gullies.

In general, where adequate soil amendments are used and grazing is properly managed, special practices for eradicating weeds in pastures are not needed; but in a few places clipping of pastures in spring and in fall may be advisable. Where the need for cropland makes the use of the soil for growing row crops and small grain necessary, runoff can be controlled and erosion prevented by a strip-cropping system. A rotation of a row crop followed by a small grain seeded to hay, which is allowed to remain for as many years as the farm program will permit, is suited to the soil. Requirements for lime and fertilizer under this system will be about the same as for the normal phase; and lime, barnyard manure, phosphorus, and potash are needed in liberal quantities. Contour tillage is essential and gullies should be controlled by check dams, but terracing is not practical on the steep slopes.

CAYLOR SERIES

As mapped in Claiborne County the Caylor soils are on low nearly level to sloping benches and fans in the limestone valleys at the foot of mountain slopes. About a fourth of them have undulating slopes and the rest, rolling slopes. Those on undulating slopes are only slightly eroded, but those on rolling slopes are slightly to moderately eroded. Most of these soils are stone-free, and none is sufficiently stony to interfere seriously with tillage. Hilly and steep phases of Talbott, Armuchee, Lehew, and Muskingum soils are on the adjoining mountain slopes (pl. 7, A), whereas the Dewey, Talbott, and Allen soils and Rolling stony and (Talbott soil material) are the associated soils in the valleys. The Caylor soils are easy to work, easy to conserve, and are among the most productive soils of the county. Reaction is medium acid.

Like other soils derived from colluvial material, the Caylor soils are somewhat variable in profile characteristics. To a depth of 8 to 12 inches they have a brown mellow friable loam or silt loam surface soil. The subsoil is yellowish-brown or light reddish-brown friable silty clay loam or silty clay with a nut structure. It is about 24 inches thick and is underlain by yellowish-brown, reddish-brown, or brown materials that range in texture from sandy clay to silty clay. Fragments of sandstone and shale are present. These layers vary in thickness and are underlain by limestone residuum or limestone bedrock.

The soils are moderately fertile, easy to work, and easy to conserve. They are good to excellent crop soils and are suited to growing a wide variety of crops. Under good management high yields can be obtained. Management requirements are concerned chiefly with supplying lime and fertilizer, although some simple practices for preventing erosion and conserving moisture may be required, especially on areas having rolling relief. The Caylor soils are mapped in three types—the silt loam and its gently sloping phase and the stony silt loam.

Caylor silt loam.—This soil is on low benches and fans in limestone valleys at the foot of mountain slopes. Its parent material is derived from colluvium and local alluvium that has been washed and rolled

from uplands underlain by calcareous shale, sandstone, and limestone. Slopes range from 8 to 15 percent, but are usually less than 12 percent. Both surface and internal drainage are moderate. Native vegetation was a mixed hardwood forest of oak, yellowpoplar, maple, black walnut, some hickory, and dogwood. Most of the soil is in Powell Valley in irregularly shaped areas of small or medium size. It is associated in a complex pattern with other Caylor soils and Allen soil on the colluvial lands and with Sequatchie, Holston, Etowah, Taft, and Robertsville soils on the adjoining stream terraces. Dewey and Talbott soils and Rolling stony land (Talbott soil material) are on the adjoining uplands, whereas the Armuchee, Lehew, Talbott, and Muskingum soils are on the nearby mountain slopes. The soil is also in Cedar Fork Valley and the valley of Little Sycamore Creek, where it is associated chiefly with Dewey and Talbott soils, Rolling stony land (Talbott soil material), and other Caylor soils. The aggregate area mapped is 1,948 acres.

The profile is similar to that of the gently sloping phase, except that the depth to the silty clay substratum is less and in most places part of the original surface soil has been removed by accelerated erosion. Where cleared, the upper 6 to 10 inches is light-brown friable silt loam having a granular structure. Reaction is medium acid. As compared with the associated soils of the upland the organic-matter content is moderately high, but in most places the humus content can easily be increased. Although the soil has lost part of the original surface layer by erosion, the subsoil is turned by tillage operations in very few places and good tilth is easily maintained. The soil absorbs and retains water readily, and moisture conditions for the growth of plants are generally good.

The yellowish-brown silty clay loam subsoil contains some small dark-brown concretions and has a fairly well developed nut structure. It is moderately friable when moist but sticky and plastic when wet. At a depth of 16 to 20 inches it is underlain by yellowish-brown or reddish-brown silty clay faintly mottled with red and yellow. Small fragments of sandstone and shale are present. This layer is variable in thickness and is underlain by limestone residuum overlying high-grade limestone of the Black River, Stone River, and Trenton formations.

Several variations are mapped. In Cedar Fork Valley and the valley of Little Sycamore Creek a few areas have sufficient angular sandstone fragments on the surface and in the surface soil to interfere with tillage, and the texture is lighter and the color browner than in Powell Valley. In the few forested areas the surface layer is about 12 inches thick, the upper inch or so being stained almost black with organic matter. In small spots enough of the original surface soil may be missing so that the upper subsoil is turned by the plow. A small area in Powell Valley has a more yellowish subsoil than normal and the lower part contains some yellowish-brown mottlings. All these variations are of relatively small extent and do not materially alter the use suitability or management requirements of the soil.

Use and management.—Caylor silt loam is fairly easy to work and to conserve and is physically good to excellent cropland. The present use and management are fairly well adjusted to the physical properties

of the soil. Practically all of this soil is cleared and under cultivation, but it is used somewhat less intensively than the gently sloping phase. Estimates show that about 30 percent is used for growing corn, 10 percent for small grains—chiefly wheat, 35 percent for hay, 5 percent for burley tobacco, and the rest is idle. A rotation of corn, small grain, and hay is used on the better farms; but in some places a systematic rotation of crops is not practiced and two or more years of row crops are followed by hay, either lespedeza or red clover and timothy. Some fields are allowed to remain idle for a year or two after being in row crops and may again be used for intertilled crops when they are broken.

Approximately half the soil is limed at fairly regular intervals. Medium to large quantities of 3-8-6 commercial fertilizer are used on tobacco by most farmers, although some may use barnyard manure and superphosphate. Corn and small grains ordinarily receive small or medium quantities of 0-10-4 fertilizer, but a few of the better farmers use larger quantities of a higher analysis similar to that used on tobacco. Hay crops are not ordinarily fertilized, but in recent years some farmers have begun to use superphosphate in addition to lime on red clover and alfalfa. Special practices for controlling runoff and preventing erosion are employed by only a few farmers. Under the present system of management average acre yields of about 37 bushels of corn, 18 bushels of wheat, 1,200 pounds of burley tobacco, 1½ tons of clover and timothy, 2¾ tons of alfalfa, and 1½ tons of lespedeza may be expected.

Requirements for good management are similar to those for the gently sloping phase, but more practices for controlling runoff are required. In addition, proper choice and rotation of crops and use of lime, fertilizer, and other soil amendments are needed. The soil is suited to moderately intensive use, and, if other management requirements are met, it can be conserved under a rotation including a row crop once in 3 or 4 years. It is well suited to growing all the common field crops including corn, burley tobacco, soybeans, wheat, oats, barley, red clover, crimson clover, and alfalfa. A rotation of a row crop followed by wheat seeded to red clover alone or with timothy is a useful 4-year rotation. Where it is feasible to have a hay crop for 3 or 4 years, alfalfa can be used.

Legumes have an important part in any rotation, for they are effective in increasing humus and nitrogen and in improving tilth and moisture conditions. Moderate quantities of lime at moderate intervals, however, are necessary to insure success with legumes. Fertilizer requirements of the various crops are essentially the same as those for the gently sloping phase. Contour tillage should be practiced everywhere, and carefully constructed and maintained broad-base terraces may be useful on the stronger slopes in controlling runoff, thereby preventing erosion and conserving soil moisture. Under good management acre yields of about 48 bushels of corn, 18 bushels of wheat, 1,500 pounds of burley tobacco, 3.6 tons of alfalfa, and 1.5 tons of lespedeza may be expected.

Caylor silt loam, gently sloping phase.—This soil lies on benches and fans of 2 to 7 percent in limestone valleys at the foot of mountain sides. Its parent material is mixed colluvium from uplands underlain by limestone, sandstone, and calcareous shale. It was developed under

a hardwood forest of oaks, maples, black walnut, yellowpoplar, and dogwood. Both internal and surface drainage are moderate. A total of 844 acres is mapped. It occurs in Powell Valley in small or medium-sized areas and in Cedar Fork Valley and the valley of Little Sycamore Creek in small areas. It is associated with Dewey, Talbott, and Allen soils and other Caylor soils in the valleys; whereas Talbott, Armuchee, Lehew, and Muskingum soils are on the adjoining mountain slopes.

This phase has a fairly well-developed profile as compared with the soils derived chiefly from limestone colluvium. The surface soil is mellow friable brown silt loam with a fine crumb structure. It is 10 to 15 inches thick and is moderately high in humus as compared with the associated soils. Reaction is medium acid. Good tilth is easily maintained, and tillage can be accomplished over a fairly wide range of moisture conditions. The soil is absorptive and retentive of moisture, and conditions for plant growth are generally better than in associated upland soils on comparable slopes. Most of the soil is entirely stone-free, but in a few places some angular fragments of sandstone are on the surface and in the soil.

The yellowish-brown or light reddish-brown silty clay loam subsoil has a weakly developed nut structure, which crushes to a yellowish-brown crumbly mass. Some small soft brown concretions and small fragments of sandstone and shale are present. This layer is 16 to 24 inches thick and is underlain by yellowish-brown or reddish-brown silty clay containing some red and yellow mottlings and small fragments of olive-green shale and red and purple sandstone. This layer is of variable thickness and is underlain by limestone residuum over high-grade limestone of the Trenton, Stone River, and Black River formations.

Several variations are mapped. In Cedar Fork Valley and the valley of Little Sycamore Creek the texture is lighter, the surface soil being a loam and the subsoil a light silty clay loam in most places. In a few places the layer of colluvium is thin and the lower subsoil is derived from limestone residuum. In Powell Valley the subsoil is more yellow, and the profile is more definitely developed than in the other valleys. None of these variations, however, is of sufficient importance to affect materially the use suitability and management requirements of the soil.

Use and management.—All of Caylor silt loam, gently sloping phase, is cleared and cultivated. Its present use is fairly well adjusted to its physical properties, but yields can be increased by more careful management. The soil is used intensively in short rotations in some places, whereas in others definite rotations are not used and several years of row crops are followed by several years of hay. It is physically excellent cropland. Corn, wheat, red clover, lespedeza, burley tobacco, and vegetables are the chief crops. Some of the soil, especially in the valley of Little Sycamore Creek and Cedar Fork Valley, is limed at periodic intervals. Most farmers fertilize tobacco heavily with a commercial mixture and also apply barnyard manure where it is available. Corn and wheat receive small to moderate quantities of lower grade materials, and most hay crops are not fertilized. The prevention of erosion and conservation of moisture are not serious problems on this soil, and no special practices for controlling runoff

are ordinarily used. Under prevailing systems of management yields of about 45 bushels of corn, 20 bushels of wheat, 1,500 pounds of burley tobacco, $1\frac{3}{4}$ tons of timothy and clover, and $1\frac{1}{2}$ tons of lespedeza to the acre may be expected.

The soil is well suited to alfalfa, and, where comparatively long rotations are feasible, it fits well into a rotation of a row crop, small grain, and hay. As the soil is suited to intensive use, it can likely be conserved where used for row crops every second or third year if other management requirements are met. A row crop followed by small grain seeded to crimson clover to be turned under as a green-manure crop is a suitable 2-year rotation.

Lime is required to insure success with legumes so as to maintain or increase the humus and nitrogen supplies. Barnyard manure is a good source of organic matter and nitrogen and in addition supplies potash, but it could be supplemented with phosphorous fertilizers to obtain the correct balance of plant nutrients. Tobacco needs liberal applications of high-grade complete fertilizers with relatively high proportions of phosphorus and potash. Corn and small grains require moderate to large quantities of similar mixtures, but the proportion of potash can be somewhat less. Legumes need large quantities of potash and phosphorus but no nitrogen. In general the fertilizer requirements of vegetables are about the same as those of tobacco. Where good tilth is maintained by careful tillage, lime used, and humus maintained or increased, no special practices for controlling runoff other than contour tillage on the stronger slopes are required. Acre yields of about 55 bushels of corn, 23 bushels of wheat, 1,800 pounds of tobacco, 2 tons of timothy and clover, 4 tons of alfalfa, and 1.7 tons of lespedeza may be expected under good management.

Caylor stony silt loam.—Areas of this soil lie as sloping fans and narrow bands along intermittent drains that rise in areas adjacent to steep Armuchee and Lehigh soils. The soil is developed on local alluvium or colluvium consisting of a mixture of material from limestone, sandstone, and shale. It is distinguished from the other Caylor soils chiefly by an abundance of stone sufficient to interfere materially with tillage operations. Both surface and internal drainage are moderate. It occurs in relatively small tracts on the floor of limestone valleys and is associated chiefly with Rolling stony land (Talbott soil material) and Talbott soils. The soil is not widely distributed, practically the entire 84 acres being confined to the valley along the northwest base of Wallen Ridge, about 2 miles northeast of Tazewell, and in the valley of Little Sycamore Creek.

The medium acid profile is similar to that of the more sandy variation of Caylor silt loam. The 6- to 10-inch surface layer is brown friable silt loam or loam with a variable quantity of sandstone and limestone fragments. The subsoil is yellowish-brown silty clay loam or loam with a fairly well developed nut structure. Sandstone or limestone fragments are common. Below the subsoil is yellowish-brown or reddish-brown silty clay faintly mottled with red and yellow. High-grade limestone bedrock is at a depth of 3 to 6 feet.

Use and management.—Most of Caylor stony silt loam is cleared, and corn, small grains, hay, and pasture are the chief crops grown. Some fields remain idle for a few years between periods of cultivation.

Under management similar to that commonly practiced on other Caylor soils, corn yields about 35 bushels an acre; wheat, 18 bushels; and lespedeza, 0.4 ton.

Chiefly because of its stony nature, the suitability of this soil for agricultural use is more limited than that of Caylor silt loam. The stone content interferes materially with field operations and is hard on heavy machinery; otherwise the soil is suited to moderately intensive use. Where moderately long rotations are used tillage should be on the contour and broad-base terraces may be feasible in places. Fertilizer requirements are the same as those for Caylor silt loam, gently sloping phase.

CLAIBORNE SERIES

The soils of the Claiborne series are in the cherty ridge sections closely associated with soils of the Bolton and Fullerton series and to a lesser extent with those of the Clarksville. They were developed from parent material weathered from moderately cherty dolomite of the Knox formation under a mixed hardwood forest of beech, maple, yellowpoplar, chestnut, and oak. They are darker in color, somewhat more fertile, and probably higher in organic matter than the soils of the Fullerton series, but less favorable in these respects than the Bolton soils. About 15 percent are rolling; 39 percent, hilly; and 46 percent, steep.

In forested sites the 10- to 12-inch surface soil is light-brown silt loam. In cleared and cultivated places this layer may be partly or entirely missing. The subsoil is yellowish-brown silty clay loam with a weakly developed nut structure. This layer is 18 to 24 inches thick and is underlain by red or yellowish-red silty clay with a well-developed nut structure. A relatively large quantity of angular chert fragments is present. At a depth of about 3 feet yellow and faint-gray mottlings are present, and the structural particles are larger and firmer. In general the chert content increases with the depth. Cherty dolomite bedrock is at depths of 20 feet or more.

About one-third of the area covered is in forest and the rest is cleared and in crops and pasture. Fifty percent or more of the clearings have been sufficiently eroded to reduce their productivity and impair their workability, whereas the rest are uneroded or only slightly eroded. Most of these soils are nearly chert free, although sufficient chert is on the surface and in the soil in places to interfere with tillage.

The profiles of the Claiborne soils are similar, but their use suitability and management requirements differ because of slope and erosion variations. The rolling and normal phases are physically suited to growing general farm crops, whereas the steep phase is best suited to pasture. Management requirements include the proper choice and rotation of crops; practices for supplying lime, mineral plant nutrients, and nitrogen; and practices for conserving soil moisture and preventing erosion. The Claiborne soils are mapped in three types—the silt loam and its rolling and steep phases.

Claiborne silt loam.—An upland soil on 15- to 30-percent slopes underlain by sandy cherty dolomite of the Knox formation. A total of 7,113 acres is mapped in close association with the Fullerton and Bolton soils and to a lesser extent with the Clarksville. Much of it is

in irregularly shaped areas near ridge tops, but some is in large continuous strips on the slopes adjacent to intermittent streams. Both internal and surface drainage are moderate. Native vegetation was a mixed forest of beech, maple, yellowpoplar, and some oak. The soil occurs throughout all the cherty ridge section of the county, but as with the Bolton soils, the largest proportionate acreages are in the general vicinities of New Tazewell, Goins, and Clouds.

The surface soil is light-brown mellow friable silt loam with a fine crumb structure. Where it is under forest it is 10 to 12 inches thick, and the upper 2 to 3 inches contain a relatively large quantity of organic matter. When the soil is cleared, a part of the surface layer is lost by erosion, and the organic-matter content is depleted by cropping and by loss of soil material. Reaction is medium to strongly acid. Good tilth is easily maintained, and moisture absorption and circulation are favorable for plant growth. A small quantity of angular chert fragments is on the surface and in the soil.

The yellowish-brown moderately friable subsoil is silty clay loam with a well-developed nut structure. It is absorptive of moisture and is easily penetrated by soil, air, water, and plant roots. It is 18 to 24 inches thick and is underlain by red or yellowish-red silty clay with a well-developed nut structure. A moderate quantity of angular chert fragments, which increases with depth, is present. This material is less permeable and absorptive than the layers above, and when those layers become saturated with water during prolonged rains, surface runoff and soil erosion are greatly increased. Cherty dolomite bedrock is at depths of 20 to 50 feet.

Variations are due to differences in the degree of accelerated erosion, the quantity of chert, and the color of the surface soil. In some places much of the original surface layer is missing, and the present surface layer is made up of a mixture of the remaining original surface and the upper subsoil. In these places, the surface layer is heavier in texture, lighter in color, and less fertile; but good tilth and favorable moisture conditions are fairly easy to maintain. From one-fourth to one-third of the soil has sufficient chert on the surface and in the soil to interfere somewhat with tillage operations, but otherwise it is essentially the same as the normal soil. Soils with this variation are widely distributed. The surface soil and subsoil are generally somewhat coarser textured and more yellow in color in the northeastern part than in the rest of the county.

Variations of a more general nature are also included with the mapping separation because Claiborne silt loam is closely associated with the Bolton and Fullerton soils and has properties intermediate between these soils. In some places where the boundary between this soil and the Bolton or Fullerton soil is not distinct, small areas of either or both of the associated soils may be included with this mapping separation. In general these variations are not of sufficient extent to alter the use suitability or management requirements of the soil areas from those of the normal type.

Use and management.—Because it is one of the more productive soils in the cherty ridge section, Claiborne silt loam is used rather intensively and management practices are not well adjusted to its physical properties. Practically all of it has been cleared and used for

crops or pasture at one time, but at present about 25 percent is in second-growth forest of shortleaf pine and yellowpoplar. About 25 percent is used for growing corn, 10 percent for small grain, 5 percent for tobacco, 25 percent for hay and pasture, and 10 percent is idle. Very few farmers practice a systematic crop rotation; corn or other row crops are grown for several years in succession followed by lespeeza or redbtop and timothy, which are harvested for hay or used for pasture. After periods of intensive use, some of the soil is allowed to remain idle for several years during which it becomes covered with brush and broomsedge. When the soil is again needed for cropping, it is cleared by grubbing and burning.

About 100 pounds an acre of 0-10-4 fertilizer or superphosphate are used under corn and small grains. Heavier applications of 3-8-6 or a similar fertilizer are used on tobacco, and barnyard manure is applied where it is available. Hay and pastures ordinarily are not fertilized, and very little of the soil is limed periodically. Average yields that may be expected under common management practices are 18 bushels of corn, 10 bushels of wheat, 700 pounds of burley tobacco, and 1 ton of lespeeza or mixed hay to the acre.

Requirements for good management are similar to those for Bolton silt loam. They include practices for supplying lime and mineral plant nutrients, for increasing or maintaining the supply of humus and nitrogen, and for conserving soil moisture and preventing erosion. These practices can be attained largely through the proper choice and rotation of crops and the correct choice and use of soil amendments, but some other special practices may be required. Where other management requirements are met, the soil can be conserved under a rotation including a row crop once in 5 years. Corn followed by a small grain seeded to a legume or legume-grass mixture for hay or pasture is a desirable rotation. Burley tobacco and vegetables are other row crops that may be expected to do fairly well. Red clover alone or in a mixture with timothy is effective in maintaining the supply of humus and nitrogen, and it also forms a protective cover that prevents excessive runoff and soil erosion. Some of the soil may be fairly well suited to alfalfa.

Applications of ground limestone are necessary to obtain good stands of legumes. In addition, liberal quantities of phosphorus and potash are required. Corn and small grains need much phosphorus and some potash. Tobacco and vegetables should be heavily fertilized with complete fertilizers containing small to medium quantities of nitrogen and large quantities of phosphorus and potash. Barnyard manure is beneficial to all crops because it furnishes potash and some nitrogen, and it improves tilth and moisture relations. Tillage should be on the contour where practicable. Terracing as a means of erosion control is probably feasible in very few places, but strip cropping may be useful, especially on the longer slopes. Gullies can be controlled by the use of check dams.

Claiborne silt loam, rolling phase.—Like other soils of the series, this phase is on uplands underlain by sandy cherty dolomite of the Knox formation. It is on cherty ridge crests in the same parts of the county as other Claiborne soils. Slopes range from 8 to 15 percent, and both internal and surface drainage are good. An aggregate area

of 2,864 acres is mapped, the largest part of which is in broad areas west and southwest of New Tazewell. It is in long comparatively narrow strips on the ridge tops in association with other soils of the series and with Fullerton and Bolton soils. Native vegetation was a mixed forest of beech, maple, yellowpoplar, and several species of oak.

The profile is essentially the same as that of the normal phase, but where it is cleared this soil has been less severely eroded and the surface soil is generally somewhat thicker. The surface 8 to 10 inches is mellow friable light-brown silt loam with a fine crumb structure. Originally the organic-matter content was relatively high, but it has been largely dissipated by continued cropping. Reaction is strongly acid. Good tilth is easily maintained, and tillage operations can be accomplished over a fairly wide range of moisture conditions. The water-absorbing capacity is relatively high and moisture conditions are generally favorable for plant growth. Some angular chert fragments and small pieces of weathered sandstone are on the surface and in the soil.

The yellowish-brown subsoil is a moderately friable silty clay loam with a nut structure. Soil moisture and air circulate freely in this layer, and roots penetrate it easily. It is about 2 feet thick and is underlain by yellowish-red or red cherty silty clay with a well-developed nut structure. The quantity of chert increases with depth and gray, ocher, and brown mottlings appear. As in the normal phase this layer is less absorptive and permeable than the overlying ones and runoff and erosion consequently are somewhat increased when the upper soil becomes saturated.

The chief variations are those due to differences in the quantity of chert and in the severity of accelerated erosion. About one-fourth of the soil has sufficient chert on the surface and in the soil to interfere somewhat with tillage operations. This variation has been indicated on the soil map by the use of chert symbols within the delineated areas. The degree of accelerated erosion varies widely, but in only a comparatively few places is enough of the original surface soil missing so that the subsoil is tilled. As with other soils of the series, the boundary between this soil and the Fullerton and Bolton soils is not sharp and small areas having similar properties to those of the associated soils are included in this mapping separation. None of these variations is so great as to affect the general use suitability or management requirements of the soil.

Use and management.—Practically all of Claiborne silt loam, rolling phase, is cleared and cultivated. Estimates indicate that about 50 percent is used for growing corn, 10 percent for small grains, 5 percent for burley tobacco, less than 5 percent for vegetables, and the rest for hay crops. Systematic crop rotations are not generally followed, and corn or tobacco may be grown for several years in succession followed by lespedeza or a grass hay crop. Some fields are allowed to lie fallow for one or two crop seasons at irregular intervals. Small quantities of 0-10-4 fertilizer are used on corn and small-grain crops, but fairly heavy applications of complete fertilizers are used under tobacco and vegetables. Although fertilizers are not ordinarily applied to hay crops, residual

effects of materials applied to the preceding crops are beneficial. Very little lime is used. Almost no special measures for the erosion control and conservation of soil moisture are practiced.

Yields are slightly less than those obtained on Bolton silt loam, rolling phase. Estimated acre yields under common management practices are about 28 bushels of corn, 11 bushels of wheat, 975 pounds of burley tobacco, and 1 ton of lespedeza or mixed hay. If lime is used in addition to other common practices, yields of about 2½ tons of alfalfa and 1½ tons of red clover are obtained.

Requirements for good management are similar to those for the rolling phase of Bolton silt loam. They are concerned chiefly with correcting the deficiencies in lime and mineral plant nutrients and maintaining or increasing the humus content, but some practices for controlling erosion and conserving soil moisture are needed. When carefully managed in other respects, this soil can be conserved under a rotation including a row crop once in 3 years. A row crop followed by a small grain seeded to an annual legume makes a desirable rotation, or a row crop followed by a legume for 2 years may also be used if it fits well into the farm-management program.

Corn, burley tobacco, tomatoes, and other vegetables are among the intertilled crops that may be expected to do well, and all small grains also are fairly well suited. Good stands of both red clover and alfalfa can be obtained if lime is applied, and these crops are effective in maintaining or increasing the humus and nitrogen supplies. All crops require liberal phosphorus applications and some potash; but legumes, burley tobacco, and some vegetables need large quantities of potash. Some vegetables need additional nitrogen in fertilizers. Barnyard manure is effective in supplying nitrogen and potash and also helps to maintain or improve tilth conditions and moisture relations, but it must be supplemented with superphosphate to obtain a proper balance of plant nutrients. Contour tillage is a desirable practice where feasible. Terraces may be useful in preventing soil erosion and conserving soil moisture, but their need should be established by careful study, and to be effective they must be properly planned and maintained.

Claiborne silt loam, steep phase.—Occurring on steep upland slopes underlain by sandy cherty dolomites of the Copper Ridge and Beekmantown formations, this phase has slopes exceeding 30 percent, with the greater extent ranging from 30 to 40 percent. Surface drainage is rapid and internal drainage moderate. The soil was developed under a mixed forest of beech, maple, yellowpoplar, and oak. The largest proportionate acreage is in the cherty ridge section of the county southwest of New Tazewell, but it is in all parts of the county underlain by dolomites, mostly in large areas on the steep slopes along the small streams that dissect the cherty ridge sections. The total area is 8,636 acres.

The virgin profile of this soil and the normal phase are similar, but the various layers may be somewhat thinner in the steep phase. Where it is cleared more of the surface soil has been lost by erosion than on the other soils of the series. The surface 4 to 6 inches is a mellow friable light-brown silt loam with a fine granular structure. It is relatively low in organic matter because of loss of the original supply by erosion and through dissipation in cropping. Reaction is strongly acid. In

some places the upper part of the subsoil may be mixed with the remaining original surface soil, but good tilth conditions are generally easily maintained. Moisture supplies are less favorable than in other Claiborne soils because of large losses of water through surface runoff. A moderate quantity of angular chert fragments is on the surface and in the soil.

The yellowish-brown subsoil is moderately friable silty clay loam with a nut structure. It is about 18 inches thick and is underlain by yellowish-red cherty silty clay with a well-developed nut structure. Sandy cherty dolomite is at a depth of 20 feet or more in most places, but it outcrops on the surface on the more severely eroded areas near the foot of some of the steeper slopes.

Variations caused by differences in the degree of accelerated erosion and in the quantity of chert are included in this mapping unit. Where the soil has remained in forest, the surface layer is about 10 inches thick; but cleared areas that have been used for crops on about one-fourth of the soil may have lost nearly all of the original surface soil. In such places tilth conditions are generally only fair, and the loss of water through runoff is greatly increased. About one-third of the soil has sufficient chert on the surface and in the profile to interfere materially with tillage operations. This condition is indicated on the soil map by chert symbols. In some places the boundary between this soil and the Bolton or Fullerton soils is not distinct, and small areas of the associated soils may be included with this mapping separation.

Use and management.—Claiborne silt loam, steep phase, is one of the more productive soils of the cherty ridges, and because it is associated with broad areas of unproductive soils it is used for purposes for which it is not well suited physically. Management practices designed to conserve the soil generally are not used. About 25 percent of the soil has never been cleared, but the remaining 75 percent has been cleared and used for agricultural purposes at one time. At present probably not more than 50 percent is cleared; a part that was cleared has been abandoned to second-growth forest of shortleaf pine and yellowpoplar. The cleared areas are used for growing corn, hay, and pasture. In many places corn is grown for 2 or 3 years in succession, after which the soil is allowed to remain idle for several years. During these years of idleness, broomsedge, sassafras, and blackberries become established and are removed by burning and grubbing when the soil is again needed for crops; some farmers, however, use these idle fields for pasture.

Lespedeza is the most commonly grown hay crop, but redtop and timothy are in a few places. Small quantities of 0-10-4 fertilizer are used on corn, but hay crops are not fertilized. Very little of the soil is ever limed. Tillage is roughly on the contour from necessity, but no other special practices for the control of runoff and prevention of erosion are used. Under common management practices, yields of about 13 bushels of corn and less than $\frac{3}{4}$ ton of lespedeza or mixed hay may be expected.

The physical properties of this phase are such that it is suited chiefly to growing pasture; and the requirements for good management are concerned with supplying amendments and conserving moisture for



A



B

A, Valley of Little Sycamore Creek and Powell Mountain, near the county line, looking southeast. Smooth stony land (Talbot soil material) in immediate foreground; Caylor soils on sloping fan in center, Talbot soils on lower hilly and steep slopes; Armuchee soils on steep upper cleared slopes; Lchew soils on wooded slopes except for a narrow band of Rough stony land (Muskingum soil material) at the crest.

B, Harvesting clover hay on Fullerton cherty silt loam, hilly phase. The cropland is chiefly on the milder slopes; forage crops or wood in the steep areas.



A, Land use is fairly well adjusted to soil conditions on this land in the Fullerton-Claiborne-Clarksville (rolling to hilly) association. Most of the cropped land is on the mild slopes of Greendale soils, except the corn in the immediate foreground, which is on Fullerton cherty silt loam, steep phase. Most of the cleared hilly and steep land is in hay or pasture, and wooded areas on steep slopes are cherty Fullerton and Clarksville soils.

B, Well-kept test demonstration farm on the Fullerton-Claiborne-Clarksville (rolling to hilly) association. Special effort was made to adjust soil uses and management to the physical conditions. The more level parts, chiefly on Greendale soils, are in crops; and the steeper Fullerton soils in either sod or forest.

pasture plants. Alfalfa, red clover, bluegrass, and white clover are among the more desirable crops; but lespedeza, redtop, timothy, orchard grass, and Bermuda grass may also be used. Legumes and bluegrass require fairly heavy phosphorus applications, some potash, and lime at periodic intervals. These crops are effective in binding the soil mass, increasing the humus content, and increasing the moisture-absorbing properties; thereby controlling runoff and preventing erosion. Grazing should be carefully regulated, especially during periods of adverse moisture conditions, to prevent damage to pasture stands. In many places it may be necessary to clip pastures at intervals to destroy weeds. Gullies can be stabilized by check dams. Some of the most severely eroded areas of the soil may be reforested, but before forest plantings can be successfully established, gullies must be brought under control by use of check dams. Moderate applications of phosphorus will assist in obtaining good stands of trees, especially black locust.

CLARKSVILLE SERIES

The Clarksville soils are on the cherty upland ridges associated with soils of the Fullerton series. They are the lightest colored of all the soils developed from parent material weathered from cherty dolomite, are lower in organic matter, more acid, lower in fertility, and generally more cherty than any other cherty ridge soil. Most of this series is on high steep ridges along Powell River and its tributaries. Relief is rolling to steep—7 percent is rolling; 29 percent, hilly; and 64 percent, steep.

The surface soil is light-gray loose cherty silt loam or loam. The subsoil is loose or brittle yellow or brownish-yellow cherty clay loam or sandy clay loam with very little definite structural development. The substratum, or parent material, is typically cherty yellow clay mottled with gray, brown, and red; in some places, however, this material may be dominantly red in color. The underlying rock is cherty dolomite of the Beekmantown and Copper Ridge formations.

About 25 percent of the soils of the Clarksville series are classified as loam and the remaining 75 percent as silt loam. Practically all the soil has sufficient chert to interfere materially with cultivation, and about a fourth has lost at least part of the original surface soil through erosion.

Because of their large extent and wide distribution these soils are relatively important to agriculture. Like the Fullerton soils, they are suited to a variety of uses and are variable in management requirements because of differences in slope, chertiness, and degree of erosion. The areas with rolling relief are fairly well suited to growing field crops, whereas the hilly phases are suited to pasture and the steep phases are best suited to forestry. Tilth and moisture conditions are only fair. Management practices designed to correct or improve soil conditions as much as practical from the standpoint of good farm management are needed on areas suited to growing crops and pasture. Under good management, fair yields of crops and pastures can be expected in normal seasons. The Clarksville soils are mapped in two types and four phases—the hilly and steep phases of the cherty loam, the cherty silt loam with its hilly and steep phases, and the loam.

Clarksville cherty loam, hilly phase.—This soil is on hilly slopes (12 to 25 percent) of cherty ridges underlain by sandy cherty dolomites of the Beekmantown and Copper Ridge formations. Most of it is in small medium-sized irregularly shaped areas on the cherty ridges along Powell River and its tributaries. A total of 1,955 acres is mapped in association with other Clarksville cherty loam soils and with cherty loam types and phases of Fullerton soils. Both internal and surface drainage are rapid. Native vegetation was a mixed forest of post, blackjack, and red oaks, hickory, dogwood, sourwood, blackgum, and probably some shortleaf pine.

The profile differs from that of the hilly phase of the cherty silt loam chiefly in that more sand is in the soil material. Under forest the surface 8 to 10 inches is loose light-gray or light brownish-gray cherty loam to fine sandy loam. The layer of forest litter is thin, and the organic-matter content is low. Reaction is strongly acid. Moisture conditions for plant growth are poor because of the strong slopes and the open porous nature of the soil. In many places large chert and sandstone boulders are on the surface and in the soil. Where the soil is cleared much of the fine soil material in the original surface layer has been removed by accelerated erosion, and the present surface is largely a mass of chert mixed with the original upper subsoil. Conditions for crop growth or pasture are poor because of the strong acidity, poor physical condition of the soil, strong slopes, and poor moisture conditions.

The subsoil is a loose mass of yellow cherty fine sandy clay with no well-defined structure. It is 18 to 24 inches thick and is underlain by moderately brittle yellow or reddish-yellow fine sandy clay with a fairly well developed nut structure. Some gray, reddish-brown, and other mottlings are present. Probably 50 percent or more of these layers is angular chert fragments. Sandy cherty dolomite bedrock is at a depth of 20 feet or more.

The chief variations mapped are due to indistinct boundaries between this phase and some other types and phases of Clarksville or Fullerton soils. Small areas of Clarksville cherty silt loam, hilly phase; Fullerton cherty loam, hilly phase; or Fullerton cherty silt loam may be included in some places. Another variation of considerable extent is due to variation in the color of the lower subsoil; in some places it is yellowish red or light red rather than yellow.

Use and management.—The present use of Clarksville cherty loam, hilly phase, like that of other hilly phases of Clarksville and Fullerton soils, is determined largely by the immediate needs of the landowner rather than the physical use suitability of the soil. At present about 75 percent of the soil is in forest; the 25 percent that is cleared is used for growing corn, hay, and pasture, although part is idle each year. Management is at a low level and is very similar to that described for Clarksville cherty silt loam, hilly phase. Crop yields are very low; under prevailing management systems about 10 bushels of corn and half a ton of lespedeza or mixed hay to the acre may be expected. Where the soil is used for forestry, no special effort is made to conserve the forests, and yields of timber are low and of poor quality.

Workability and conservability are so difficult on this soil that it is very poorly suited to growing crops under present conditions, but, if

carefully managed, it may be used for pasture. Pasture management requirements are concerned chiefly with choosing proper pasture mixtures, using soil amendments correctly, and controlling grazing. The practices described for the hilly phase of Clarksville cherty silt loam are applicable to this soil. Where the soil is severely eroded, where it is distant from water supplies for livestock, and where it is extremely cherty, it is probably not suited to pasture but is best used for forestry, with practices similar to those for forest on other cherty ridge soils being used.

Clarksville cherty loam, steep phase.—Derived from parent materials weathered from cherty dolomites of the Copper Ridge and Beckmantown formations, this soil has developed under a mixed forest chiefly of oak, hickory, blackgum, sourwood, and dogwood. Nearly pure stands of shortleaf pine may have been on some of the more droughty areas. Slopes range from 25 to 50 percent, but are predominantly 30 to 40 percent. Both surface and internal drainage are rapid. The soil is in all the cherty ridge sections of the county, but mostly on the ridges adjacent to the Powell River and its tributaries. Usually it is in long relatively broad strips on the steep slopes along the streams, in association with other loam types of Clarksville soils and with loam types and phases of Fullerton soils. The total area mapped is 4,328 acres.

The profile is similar to that of the hilly phase, but the various layers may be somewhat thinner and bedrock is at a shallower depth. Under forest, the surface 8 inches is loose, porous cherty loam to fine sandy loam. The layer of forest litter is thin, and the organic-matter content is low. The soil is very strongly to extremely acid in reaction. Moisture conditions for plant growth are poor because of the rapid loss of water through runoff and the open, porous nature of the soil. Sandstone and chert boulders are on the surface in many places. Where the soil is cleared, most of the fine soil material in the surface layer is soon lost through erosion, and conditions for crop growth or pasture are very poor.

The 18-inch subsoil is a rather loose open cherty fine sandy clay with no apparent distinct structural development. It grades into yellow or reddish-yellow cherty fine sandy clay mottled with gray, brown, ocher, and red, with a fairly well developed nut structure. Sandy cherty dolomite bedrock is at a depth of 20 feet or more in most places; but the rock floor is somewhat uneven and surface outcrops are in many places, especially along the lower slopes.

The chief variations mapped are due to the indistinct boundaries between this soil and some associated soil. Small areas of steep phases of Fullerton soils and of Clarksville cherty silt loam are probably included in many places. In many places the lower subsoil is reddish yellow or light red in color. None of these variations is of sufficient extent to alter the use suitability of the soil.

Use and management.—At present most of Clarksville cherty loam, steep phase, is in forest, but small areas are cleared and used for growing corn and hay. As with other infertile soils on steep slopes, management is at a low level and is concerned chiefly with plowing, planting, and harvesting the crop. Yields are very low, probably not exceeding 8 bushels of corn and half a ton of hay to the acre on the

average. Where the soil is in forest, no special conservation measures are used. Timber yields are low and of poor quality, and under present systems of management, they will become progressively lower and poorer. The rate of growth of forest trees is slow as compared with that for similar soils on milder slopes or for more fertile soils on similar slopes.

Soil conditions are so poor that neither crops nor pasture are suited; and, although yields and quality of timber are lower than on many other soils, this phase is best used for forestry. Specific management requirements vary according to past management and the present condition of the soil and the forest stand. Cleared areas should be reforested either by natural reproduction or by planting suitable species of trees. All forests should be protected from fires and grazing, and harvesting should be planned to improve the quality of timber and to insure crops at periodic intervals.

Clarksville cherty silt loam.—A total area of 1,647 acres of this soil is widely distributed on the crests of ridges underlain by cherty dolomites of the Beekmantown and Copper Ridge formations. It is in long narrow strips associated chiefly with other Clarksville soils and with cherty types and phases of Fullerton soils. The largest acreage is on the crests of the high steep ridges along the Powell River. Slopes range from 5 to 12 percent. Both internal and surface drainage are moderate. The soil was developed under a mixed hardwood forest of post, blackjack, and red oaks, some hickory, dogwood, blackgum, and sourwood.

The profile resembles that of Fullerton cherty silt loam in some respects, but it differs in that the subsoil is yellow rather than red and the quantity of chert on the surface and in the soil is greater. The surface 10 inches, under forest, is loose floury light-gray cherty silt loam. Where cleared, part of this layer has been lost by accelerated erosion, but in most places enough remains to form the plow layers. In some places most of the finer soil material is missing, and the surface layer consists chiefly of a mass of angular chert fragments. Under forest, the humus content is low; and where cleared, it has been almost completely dissipated through cropping and erosion losses. Reaction is very strongly acid. Moisture moves through the soil rapidly, and the water-holding capacity is relatively low because of the large quantity of coarse material; consequently, crops are severely injured by prolonged droughts.

The subsoil is firm brittle yellow or brownish-yellow cherty silty clay loam. It has no well-defined structure, and, under normal moisture conditions, it crushes to a soft incoherent mass. This layer is about 24 inches thick and grades into yellow or reddish-yellow clay mottled with red, gray, and brown. By volume, half or more of these two layers are angular chert fragments 1 to 6 inches in size. Cherty dolomite bedrock is at depths of 20 feet or more below the surface.

The chief variations are due to differences in erosion and the quantity of chert on the surface and in the soil. In many places the lower subsoil is red or yellowish red instead of dominantly yellow. Small areas of Fullerton soils are included either because they are too small to delineate on the scale of the map used or because the boundary between the soils is not sharp.

Use and management.—The present use of Clarksville cherty silt loam is fairly well adjusted to its physical properties, but management practices are not designed to compensate for the soil deficiencies nor to correct them. Nearly all the soil has been cleared at one time; but part has been abandoned because of its low productivity, and at present about 25 percent is in forest. Estimates indicate that about 15 percent is used for growing corn, 30 percent is used for hay and pasture, and most of the remaining 30 percent is idle land; but small areas are used for growing tobacco, vegetables, and small grains.

General management practices are very similar to those for comparable Fullerton soils. Crops are not rotated. Corn may be grown for 1 or 2 years, after which the soil is idle, and broomsedge and other wild grasses and brush become established. Fields so managed usually remain idle, but some of them are used for pasture or cut for hay. When they are again needed for corn they are cleared by burning. Lespedeza, timothy, and redtop are the chief hay crops, although a small acreage of red clover is grown following burley tobacco. Some fertilizer is used on corn, but none is ordinarily applied to hay or pasture. Tobacco receives barnyard manure where available and in most places moderate to large quantities of commercial fertilizer also. Very little of the soil is ever limed. No special practices for control of runoff and prevention of erosion are ordinarily used. Under common management, yields of about 15 bushels of corn, 8 bushels of wheat, 450 pounds of burley tobacco, and less than $\frac{3}{4}$ ton of lespedeza or mixed hay to the acre may be expected. Many farmers say that although tobacco yields are low, the quality is generally better than that obtained on the more productive soils.

Like other cherty ridge soils, this soil is somewhat exacting in management requirements. It is concerned chiefly with properly choosing and rotating crops, supplying lime and fertilizer, increasing the humus content, improving tilth within practical limits, conserving soil moisture, and preventing erosion. Management practices described for Fullerton cherty silt loam are applicable to this soil. Under good management, fair yields of crops of good quality may be expected. In some of the more severely eroded and most cherty areas, soil conditions are so unfavorable that the soil is suited to neither crops nor pasture and is best used for forestry.

Clarksville cherty silt loam, hilly phase.—This phase was developed from materials weathered from cherty dolomites of the Copper Ridge and Beekmantown formations under a mixed forest of post, blackjack, and red oaks, some hickory, dogwood, blackgum, and sourwood. Slopes range from 12 to 25 percent. Internal drainage is moderate and external drainage, rapid. The soil is mapped on 5,227 acres in all the cherty ridge sections of the county associated with other Clarksville soils and with cherty types and phases of Fullerton soils. It is chiefly in small or medium-sized areas on the upper ridge slopes, but there are several broad areas of large extent in the ridges on the southeast side of Powell Valley.

The various layers in the profile may be somewhat thinner than in the normal phase, and where cleared, most of the original surface soil is missing. Under forest, the surface 8 to 10 inches is loose floury light-gray cherty silt loam. The layer of forest litter is thin, and the

content of organic matter and mineral plant nutrients is low. The soil is strongly to very strongly acid in reaction. Large chert boulders are on the surface in many places. Where the soil is cleared, most of the fine soil material that was in the original surface layer is missing, and the present surface soil is a mixture of angular chert fragments and upper subsoil material. Moisture conditions for plant growth are poor because of rapid runoff, low moisture-absorbing properties, and rapid percolation of water through the soil. Tillage is difficult because of the large quantity of chert on the surface and in the soil.

The subsoil is firm, somewhat brittle, yellow or brownish-yellow cherty silty clay loam. Angular chert fragments constitute one-half or more of the volume of the layer. The soil has no well-defined structure and crushes to a soft incoherent mass. It is 18 to 24 inches thick and is underlain by yellow or reddish-yellow cherty clay with a fairly well-developed nut structure. Cherty dolomite bedrock is at depths of 20 feet or more in most places.

The most extensive variation mapped is due to color variations of the lower subsoil. In many places in areas of small or moderate extent, the lower subsoil is yellowish red or light red similar to that of Fullerton soils. Small areas of cherty Fullerton soils are included in this mapping separation either because they are too small to delineate on the map or because the boundary between the soils is not sharp. Variations due to differences in the degree of accelerated erosion are indicated in the description of the surface soil.

Use and management.—The present use of Clarksville cherty silt loam, hilly phase, is determined largely by the immediate needs of landowners or operators rather than by the physical use suitability of the soil. At one time about 50 percent of the soil was cleared, but at present about 70 percent is in forest. Corn, hay, and pasture are the chief crops; but small acreages of tobacco and other crops are grown in some places. As with other cherty ridge soils, management is at a low level. Corn is grown for 1 to 2 years, followed by hay or several years of idleness. Lespedeza is the chief hay crop, but pastures consist chiefly of broomsedge and other wild grasses. Small quantities of fertilizer are used on corn, and fairly heavy applications are used on tobacco; hay crops, however, are not ordinarily fertilized. Very little of the soil is ever limed. Contour tillage is practiced in many places, but other special devices for controlling runoff and preventing erosion are not used. Under these prevailing management practices, yields of about 13 bushels of corn, 375 pounds of burley tobacco, and $\frac{1}{2}$ ton of lespedeza or mixed hay to the acre may be expected.

Where the soil is in forest, no special methods of forest management are used. The forest is not protected from fire or grazing, and no attempt is made to control diseases or insect pests. Selective cutting is not practiced, and no attempt is made to improve the quality or yield of timber. Reforestation is ordinarily by natural reproduction.

Because of low natural fertility, strong acidity, strong slopes, poor moisture conditions, and chertiness, this phase is not well suited to growing crops; but under careful management it will produce fair pasture. Pasture-management requirements are similar to those for

comparable phases of Fullerton soils. They are concerned chiefly with proper choice of pasture mixtures, correct use of soil amendments, and proper control of grazing. Bluegrass and white clover are well suited to the soil. Orchard grass, reedtop, hop clover, lespedeza, and Bermuda grass are other pasture plants that may be expected to do well.

Lime and phosphorus are needed, but relatively small applications at rather frequent intervals are preferable to large applications at long intervals. Potash is possibly needed. Nitrogen is useful in establishing good pasture stands, but, after they are established, its continued use is unnecessary where legumes are included in the mixture. Lespedeza and Bermuda grass can be grown with only few amendments under relatively poor soil conditions. These plants yield pastures of lower quality, but they may improve soil conditions if properly managed so that better stands can be obtained.

Grazing should be carefully controlled during droughts to prevent injury to pasture stands. Proper grazing is also effective in keeping down weeds, but clipping once or twice a year may be necessary in some places. Gulches can be stabilized by check dams. Much of the soil is distant from flowing streams or springs, and water must be provided for grazing livestock. Ponds or reservoirs for collecting and storing rainfall are useful in some places, whereas in others it may be more practical to pipe supplies from springs or cisterns. In some places where the soil is extremely cherty or severely eroded and where there is no practical method of obtaining water, the soil is best used for forest. Some needed forestry methods are (1) planting suitable species of trees, (2) protecting from grazing and fires, (3) removing weed trees, and (4) selective cutting in established forests.

Clarksville cherty silt loam, steep phase.—This phase occupies a total of 11,819 acres on the slopes of ridges underlain by cherty dolomite of the Beekmantown and Copper Ridge formations. Slopes range from 25 to 50 percent, but are usually 30 to 40 percent. Surface drainage is very rapid and internal drainage, moderate. Native vegetation was a hardwood forest of post, blackjack, and red oaks, hickory, blackgum, sourwood, and dogwood. The soil is in all cherty ridge sections of the county, with the largest acreage on the ridges along the Powell River and its tributaries. It is in long moderately broad strips of large size on the steep slopes along the streams, chiefly in association with other Clarksville soils and Fullerton soils.

The profile is very similar to that of the hilly phase. Under forest, the upper 8 to 10 inches is loose floury light-gray cherty silt loam. Organic-matter content is very low, and reaction is very strongly acid in most places. Moisture conditions are poor because of the loss of water through rapid runoff and the poor water retaining properties of the soil. Large chert boulders are on the surface in many places. Where cleared, most of the original surface soil material has been lost by accelerated erosion, and the present surface layer is a mixture of the upper subsoil material and angular chert fragments. Moisture conditions for plant growth are very poor, and tillage is difficult because of chertiness and steep slopes.

The 18- to 24-inch subsoil is yellow or brownish-yellow silty clay loam containing a large quantity of angular chert fragments. It

grades into yellow or reddish-yellow cherty clay with a fairly well developed nut structure. Cherty dolomite bedrock is at a depth of 20 feet or more in most places; but it may outcrop on the surface, especially on the lower slopes.

The most extensive included variation is due to differences in the color of the lower subsoil. Many small or medium-sized areas have yellowish-red or red lower subsoils similar to those of the Fullerton soils. Small areas of Fullerton cherty silt loam, steep phase, are included in this mapping unit either because they are too small to delineate on the soil map or because the boundary between the soils is not sharp.

Use and management.—The present use of Clarksville cherty silt loam, steep phase, is variable and is determined largely by the needs of the landowners and operators rather than by the physical use suitability of the soil. Estimates indicate that at present about 75 percent of the soil is in forest. The cleared area is used for growing corn, hay, and pasture, and a part of it is idle or abandoned. Good management methods are not practiced. Corn is grown for 1 or 2 years followed by lespedeza or several years of idleness. Pastures are chiefly broomsedge and other wild grasses. Small quantities of commercial fertilizer are used on corn, but otherwise the soil ordinarily receives no amendments. Contour tillage is practiced from necessity, but no other special practices for preventing erosion or conserving moisture are used. Crop yields are very low, those of corn being about 8 bushels to the acre and hay less than half a ton on the average. Where the soil is used for forestry, no special methods of forest management are practiced. No attempts to prevent fires and grazing and to control insect pests and diseases are made. Selective cutting is not practiced. Yields are small and of poor quality and will become progressively smaller and poorer under present management.

This phase is suited to neither crops nor pasture because of low fertility, strong acidity, chertiness, steep slopes, and poor moisture conditions. It is best used for forest, although forest growth is slower and of lower quality than that on many other cherty soils. Areas now in forest should remain so and cleared areas should be reforested. The more severely eroded cleared areas may require some special soil preparation before satisfactory stands of trees can be obtained; gullies should be stabilized by check dams. Certain species of trees benefit from applications of phosphorus. Young forest plantings should be carefully protected from fires and grazing, and, in some places, simple practices for controlling rodents and insect pests may be useful. Harvesting trees in established forests should be planned to remove undesirable and mature trees so that a timber crop may be harvested at periodic intervals.

Clarksville loam.—This inextensive soil is on the crests of cherty ridges underlain by sandy dolomite. It is mapped on 179 acres on the ridge tops on the northwest side of the Powell River associated chiefly with Fullerton loam and other loam types and phases of the Clarksville and Fullerton soils. Slopes are 5 to 12 percent. Both internal and surface drainage are good. Native vegetation was a mixed forest of oak, hickory, blackgum, sourwood, and dogwood.

To a depth of 6 or 8 inches the surface soil is yellowish-gray loose loam to fine sandy loam. It is low in organic matter and strongly acid in reaction. Roots, air, and soil moisture easily penetrate the soil, and consequently it may be somewhat droughty because of the low water retaining properties. Good tilth is maintained with ease, and the soil can be worked over a wide range of moisture conditions. Small pieces of chert and sandstone are on the surface and in the soil, although much less chert is present than on other Clarksville soils.

The subsoil, which is about 24 inches thick, is light brownish-yellow or yellow light sandy clay loam. It has no definite structure and is easily crushed to a soft incoherent mass. A small quantity of angular chert fragments is present. This layer grades into yellowish-brown or reddish-yellow light sandy clay with a weakly developed nut structure. It is mottled with gray, brown, red, and ocher, and may contain some angular chert fragments. Sandy dolomite is at a depth of 20 feet or more.

Use and management.—Clarksville loam is physically fair to good cropland. Its present use and management are fairly well adjusted to its physical properties. At present practically all of it is cleared and cultivated to all the common field crops. Management practices are variable but in general are similar to those on other cherty ridge soils. In many places the soil is associated with Fullerton loam in the same field, and management practices are essentially the same for both soils. Yields under common management practices are about 18 bushels of corn, 10 bushels of wheat, 600 pounds of burley tobacco, and $\frac{1}{2}$ ton of lespedeza hay.

Requirements for good management are concerned chiefly with the proper choice and rotation of crops, correct choice and use of soil amendments, control of runoff, and prevention of erosion.

COLBERT SERIES

The soil of the Colbert series is in the limestone valleys closely associated with the Talbott soils and the miscellaneous land types of Talbott soil material. It is underlain by clayey limestone and differs from Talbott soils in being lighter in color, heavier in texture, and more compact in the subsoil. It also is more strongly acid in reaction and lower in plant nutrients. The soil is mapped on the uplands in small areas in all the limestone valleys of the county.

The surface soil is gray or dark-gray silt loam or silty clay loam. The subsoil is compact tenacious yellow or greenish-yellow silty clay. Clayey limestone bedrock is at a depth of 2 to 3 feet, and surface outcrops are common.

Although the Colbert soil is difficult to work and to conserve, it is fairly fertile. Pasture is its best use, and management requirements are concerned chiefly with conserving moisture and supplying lime, nitrogen, phosphorus, and potash to pasture crops. The eroded phase of the silty clay loam is mapped.

Colbert silty clay loam, eroded phase.—Underlain by clayey or shaly limestone of the Black River formation (10), small areas of this soil occur on limestone valley uplands throughout the county. On

uncleared areas a mixed forest of redcedar, oak, blackgum, and sweetgum is present, and the soil was probably developed under a similar forest cover. Slopes are 2 to 10 percent, but mostly less than 5 percent. Surface drainage is moderate, but internal drainage is slow because of the impermeable subsoil and the shallow depth to bedrock.

In most places the surface soil is a gray or dark-gray heavy silty clay loam about 4 or 5 inches thick, but where the soil has been seriously eroded this layer may be missing. It is sticky and plastic when wet and moderately friable and crumbly when moist. Reaction is very strongly acid. In some places the upper inch or two is fairly high in organic-matter content, but in general the content is low. Good tilth is difficult to maintain, and the range of moisture conditions over which tillage can be carried on is very narrow. If plowed or cultivated when too wet, the soil becomes hard and cloddy, but tillage is practically impossible when the soil is dry. Fragments and slabs of limestone rock are on the surface in many places.

The subsoil is compact tenacious yellow or greenish-yellow heavy silty clay. It is very sticky when wet, and hard and intractable when dry. Soil moisture moves very slowly through this layer, and consequently most of the water that falls on the soil is lost in runoff. Clayey limestone, at a depth of about 2 feet, contains thin shaly layers in some places. The rock floor is uneven, and outcrops and ledges of limestone on the surface are common.

Variations are due to differences in the degree of erosion and differences in color of the surface soil and subsoil. On a few areas the original surface soil has been removed by erosion and the upper part of the original subsoil is now on the surface. Near New Tazewell a few areas have a nearly black surface soil, and in the vicinity of Harrogate some areas have a brownish-yellow or light-brown subsoil. The use and management requirements of all these variations are essentially the same as those of the eroded phase.

Use and management.—The use and management of Colbert silty clay loam, eroded phase, depend largely upon the use and management of the associated Talbott soils. Practically all this soil is cleared; about 25 percent is used for growing corn and the rest is in hay and pasture. Some amendments are used on the corn crop, but corn yields are very low under common management practices. In general, pastures are not treated with either lime or fertilizers, and about 40 cow-acre-days of grazing may be expected on the average. Special practices for control of runoff and erosion are not used.

Few areas of this soil are large enough to be used as fields, and consequently their management requirements are determined largely by the requirements of the associated areas of Talbott soils. In general, the soil cannot be conserved where used for tilled crops. Where it is necessary to use the soil for tilled crops, however, management requirements are similar to those of Talbott silty clay loam, eroded phase. Among the important pasture management practices are (1) liberal application of lime, phosphate, and potash; (2) weed eradication; and (3) proper control of grazing.

DEWEY SERIES

The Dewey soils are in the low-lying undulating to rolling limestone valleys, chiefly on the valley slopes and low hilltops. They are asso-

ciated in an intricate pattern with Talbott and Caylor soils and to a lesser extent with the Allen soil. These soils are in small or medium-sized areas in Powell and Cedar Fork Valleys and the valley of Little Sycamore Creek. About 70 percent is undulating and rolling; 23 percent, hilly; and 7 percent, steep. Practically all of these soils are eroded, and about one-fourth is sufficiently cherty to interfere with cultivation. Reaction is acid, and supplies of humus, nitrogen, phosphorus, and possibly potash are at least moderately deficient. Most of the soils are moderately eroded and are susceptible to further erosion.

In virgin areas the surface soil is friable grayish-brown or light-brown silt loam to a depth of 8 to 12 inches. In some places part or all of this layer may have been removed by accelerated erosion. The subsoil is yellowish-red, red, or light-red silty clay with a well-developed nut structure. It extends to a depth of about 36 inches and is sticky and plastic when wet but moderately friable when moist. The substratum is a heavy sticky plastic yellowish-red silty clay faintly mottled with red, yellow, and gray. It extends to a depth of 20 feet or more and is underlain by massive high-grade or slightly cherty limestone.

Corn, burley tobacco, small grains, clover, alfalfa, soybeans, ledeza, and pasture grasses are well suited to these soils. Management practices should replenish or increase the supplies of lime and plant nutrients, conserve moisture, and prevent erosion. Two types and three phases, the cherty silt loam, the silt loam, and the eroded, the eroded hilly, and the eroded steep phases of the silty clay loam, are mapped.

Dewey cherty silt loam.—A total area of 728 acres of this soil is mapped on well-drained uplands underlain by a cherty layer of the Stone River limestone formation (9). Slopes are 5 to 15 percent, but the slope pattern is complex because of numerous small lime sinks. Most of this soil is in Cedar Fork Valley, but a few small irregularly shaped areas are in the valley of Little Sycamore Creek in association with various limestone valley soils. Areas are in long strips of comparatively large size that are parallel to the length of the valley and are associated principally with Rolling stony land (Talbott soil material). Native vegetation was a mixed forest of oak, hickory, maple, beech, black walnut, and some redcedar.

The 8-inch surface soil is a grayish-brown friable silt loam containing a relatively large quantity of small angular black chert fragments. Reaction is medium to strongly acid. The organic-matter content is fairly high, and good tilth is fairly easily maintained. Chert fragments may interfere somewhat with tillage; but they increase the permeability and porosity of the soil, making conditions for movement of air, water, and plant roots better and susceptibility to erosion less than on Dewey silty clay loam, eroded phase.

The upper subsoil is yellowish-brown moderately friable cherty silty clay loam about 12 inches thick. It is underlain by 15 to 18 inches of yellowish-red to red heavy silty clay containing small brown concretions. These subsoil layers have a nut structure and are sticky and plastic when wet but moderately friable when moist. The substratum is moderately cherty red silty clay containing faint streaks and mottlings of yellow, brown, and gray. The rock floor, which is at

depths of 4 to 10 feet, is very jagged and uneven; outcrops are on the surface in some places.

Considerable variations were mapped, including differences in the color of the surface soil, the quantity of chert, and the texture of the subsoil. The color of the surface soil ranges from grayish brown to gray. The quantity of chert on the surface and in the profile is variable, and areas of chert-free soils too small to separate on the soil map are included. In Cedar Fork Valley a few small areas of cherty soils that have a heavy subsoil similar to that of the Talbott soils are included. All these variations, however, are essentially the same as the normal soil in physical use suitability and management requirements.

Use and management.—The present use and management of Dewey cherty silt loam is fairly well adjusted to the physical character of the soil. Nearly all the soil is cleared and used for crops, but about 10 percent is idle during each crop season. About 25 percent is used for growing corn, 25 percent for wheat, 5 percent for tobacco, and the rest for hay crops and pasture. Many farmers use a rotation of tobacco or corn, wheat, and lespedeza; but some grow a higher yielding legume as alfalfa or red clover instead of lespedeza. The common practice is to apply 100 to 150 pounds an acre of low-analysis commercial fertilizer on the corn crop and a similar quantity on wheat. Heavy applications of a commercial fertilizer as 3-8-6 are used on tobacco, or, where available, heavy applications of barnyard manure supplemented with superphosphate are used. No fertilizer is ordinarily used directly on hay, but the unused residues from other crops furnish needed plant nutrients. About half the soil receives lime at fairly regular intervals. Engineering methods of controlling runoff are not commonly used, but tillage is generally roughly on the contour. Under prevailing management, yields of about 30 bushels of corn, 15 bushels of wheat, 800 pounds of burley tobacco, and 1¼ tons of lespedeza hay to the acre may be obtained. Where lime is used in addition to other practices, acre yields of about 3 tons of alfalfa and 1½ tons of red clover may be expected.

Management requirements are similar to those for Dewey silty clay loam, eroded phase, but the requirements for conservation of soil material and moisture are somewhat less. Good management practices include increasing humus and organic matter; supplying lime, phosphorus, and potash; and preventing erosion. Under a 4-year rotation including a row crop for a year, a small grain for a year, and a legume for the rest of the time, this soil can be conserved. Alfalfa and red clover are effective both in increasing the content of humus and nitrogen and in controlling runoff. Applications of lime and phosphorus and possibly potash are required to establish good stands of legumes. Barnyard manure is also effective in supplying nitrogen and in maintaining good tilth and moisture conditions. Contour tillage is a good practice, but strip cropping is not feasible in many places because of the size and shape of the soil areas. If intertilled crops are needed at moderately frequent intervals, terracing may offer an effective means of runoff control if the terraces are carefully planned, constructed, and maintained.

Dewey silt loam.—Although this is probably the most productive soil of the uplands, it is relatively unimportant because of its small area, 168 acres. It is on well-drained undulating uplands underlain by high-grade limestone. Slopes are 3 to 8 percent, but usually less than 5 percent. Small-sized areas occur in Powell Valley and in the vicinity of New Tazewell, and a few small areas are in Cedar Fork Valley and the valley of Little Sycamore Creek on the crests of low hills in association with Dewey silty clay loam, eroded phase. Native vegetation was a mixed deciduous forest of oak, hickory, maple, walnut, and beech.

The surface soil is grayish-brown or light-brown friable heavy silt loam with a fine crumb structure. It is 8 to 12 inches thick and is medium acid in most places. The organic-matter content is comparatively high as compared with that of other upland soils. Stone and chert are not present. Good tilth is easily maintained, and, although air and water circulate freely, the soil is retentive of moisture.

The subsoil is light-red or red silty clay with a nut structure. It is sticky and plastic when wet but moderately friable when moist. Some angular chert fragments are present, and small dark-brown concretions are in the lower part. This layer is about 3 feet thick and is underlain by heavy red silty clay that is mottled with olive, red, yellow, gray, and ocher. Limestone bedrock is at a depth of 20 feet or more in most places.

Use and management.—All of Dewey silt loam is cleared and cultivated to corn, tobacco, wheat, hay, and vegetables. The present use and management of the soil are moderately well adjusted to its physical properties, but increases in yields can be obtained by improved farming practices. Some farmers use a rotation of a row crop followed by small grain and hay, but many small areas are used for tobacco several years in succession. Barnyard manure and heavy applications of commercial fertilizer are used under tobacco, and crimson clover, rye, or some other cover crop is planted after the tobacco is harvested. Many small areas are used continuously as home vegetable gardens and receive heavy applications of both barnyard manure and commercial fertilizer. Some areas that are included in fields with Dewey silty clay loam, eroded phase, are used and managed in the same manner as that soil. Expected acre yields under common management are 1,000 pounds of burley tobacco, 35 bushels of corn, 20 bushels of wheat, 1½ tons of lespedeza, 1¾ tons of red clover, and 3½ tons of alfalfa.

Requirements for good management are concerned chiefly with supplying mineral plant nutrients and lime and maintaining the humus supply, but simple practices for runoff control also are needed. The soil is suited to intensive use, and it can be conserved under a rotation including a row crop once in 3 years. Where row crops as tobacco or vegetables are grown for several successive years, winter cover crops including crimson clover, rye, and winter oats are effective in maintaining the nitrogen supply and in preventing erosion. The soil is acid and applications of lime are necessary to obtain good yields of legumes. Lime, however, should not be applied immediately prior to

the planting of tobacco, potatoes, and some vegetable crops. All crops require moderate to heavy applications of mineral fertilizer containing phosphorus and possibly potash. Barnyard manure is valuable as a source of humus, nitrogen, and potassium. Contour tillage is advisable, but mechanical devices for runoff control are not ordinarily necessary.

Dewey silty clay loam, eroded phase.—Like other soils of the Dewey series, this phase is on well-drained uplands underlain by high-grade or slightly cherty limestone of the Stone River, Black River, and Trenton formations (9). It was developed under a deciduous forest of oak, hickory, black walnut, and maple. Slopes range from 8 to 15 percent in gradient, but are mostly between 8 and 10 percent. An aggregate area of 1,175 acres is mapped, chiefly in Powell Valley in association with other Dewey soils and with soils of the Talbott, Caylor, and Allen series. Areas also are in the vicinity of New Tazewell in association with Fullerton soils and in Cedar Fork Valley and the valley of Little Sycamore Creek in association with Talbott soils.

Part of the original surface layer has been lost by accelerated erosion. The 8-inch upper layer is grayish-brown moderately friable silty clay loam with a fine crumb structure. It is medium to strongly acid and is moderately low in organic matter as a result of intensive cropping and loss of material by erosion. Where little of the original material has been lost, it is easily maintained in good tilth, but over much of the area sufficient material has been lost to permit mixing the heavier subsoil with the remaining original surface soil. In such places, the plow layer is sticky and plastic when wet and hard and intractable when dry. On the more severely eroded areas the surface soil bakes and cracks during droughts. A small quantity of fine chert fragments is on the surface and in the soil.

The upper subsoil layer is underlain by about 30 inches of yellowish-red, red, or brownish-red silty clay with a fairly well developed nut structure. This material is sticky and plastic when wet but moderately friable when moist. Small dark-brown concretions are common in the lower part. It grades into sticky plastic red silty clay that is faintly streaked and mottled with olive, yellow, brown, and gray. Bedrock is at a depth of 20 to 30 feet.

Variations are due to differences in the degree of accelerated erosion. In Powell Valley a variation of small extent includes areas in which the soil apparently contains a small quantity of sandy colluvial material in the upper layers. The soil in these places is lighter in texture throughout the profile than that of the normal soil, but it is similar in other characteristics and in physical suitability for use.

Use and management.—The present use and management of Dewey silty clay loam, eroded phase, vary from farm to farm; but, in general, they are only fairly well adjusted to the physical character of the soil. Practically all the soil is cleared and cultivated; 30 percent is used for hay and the rest for other crops, including corn, wheat, tobacco, and pasture. Some farmers commonly use a rotation of corn or tobacco, small grain, and hay; but in many places where no definite rotation is followed corn or tobacco may be grown for several years in succession, followed by small grain, lespedeza hay, or volunteer pasture. Corn is usually fertilized with about 100 pounds an acre of 0-10-4 or its

equivalent, and barnyard manure may be applied where available. Heavier applications of both commercial fertilizer and manure are used for tobacco, but neither is commonly used for hay or pasture. Small grains usually are not fertilized or are fertilized only lightly. Probably less than one-fourth of the soil is limed periodically. Engineering methods for controlling runoff are not commonly used, but tillage is generally roughly on the contour. Under common management, about 25 bushels of corn, 15 bushels of wheat, 600 pounds of burley tobacco, and 1 ton of lespedeza hay to the acre may be expected. On farms where lime is used for legumes, $2\frac{1}{2}$ tons of alfalfa or $1\frac{1}{4}$ tons of red clover to the acre are expected yields.

The requirements for good management center about increasing the organic-matter and nitrogen contents, preventing further erosion, supplying phosphorus and perhaps potassium, and improving the physical condition of the plow soil and moisture relations of the soil and crop. Runoff can be controlled and organic-matter and nitrogen contents can be increased by the growth of legumes, such as alfalfa or red clover during much of the rotation. Clean-cultivated row crops should not be grown more than once in 4 years. One year of small grain followed by a legume for hay or pasture would complete a desirable rotation and maintain or increase the organic-matter and nitrogen contents.

Lime at the rate of 2 to 3 tons an acre should be applied, and liberal applications of phosphorus are necessary for good growth of legumes. Response to potassium may be also expected. Barnyard manure is very beneficial in supplying nitrogen and potassium and in improving the tilth and moisture relations of the soil; it is especially effective in obtaining stands of alfalfa. Cultivation should be on the contour and strip cropping should be considered in favorable situations for runoff control. If the system of farming is such that it is not feasible to keep the soil in close-growing or sod-forming crops much of the time, terracing should be considered as a means of controlling runoff, but terraces must be properly constructed and well maintained to be effective.

Dewey silty clay loam, eroded hilly phase.—This soil is on well-drained uplands underlain by high-grade or slightly cherty limestone in association with other Dewey soils and with Talbott soils. It was developed under a deciduous forest of oak, hickory, maple, and black walnut. Slopes range from 15 to 30 percent. Surface drainage is rapid and internal drainage, moderate. A total area of 671 acres is mapped in small to medium-sized irregularly shaped areas.

The profiles of this phase and of the eroded phase are essentially the same, but almost all of the original surface layer has been lost on this phase. The surface 6 inches is typically a grayish-brown moderately friable silty clay loam, but where erosion has been severe, this layer may be entirely missing. Reaction is generally strongly acid, and the organic-matter content is relatively low as a result of erosion and cropping. Good tilth is moderately difficult to maintain in most places because the plow layer includes part of the heavy subsoil, and it may be sticky and plastic when wet and hard and intractable when dry. A moderate quantity of chert is on the surface, and fragments of limestone rock are in some places. A few bedrock outcrops are on the surface of the most severely eroded areas.

The surface layer is underlain by 24 to 30 inches of light-red, red, or brownish-red silty clay loam that has a fairly well developed nut structure and contains small to medium quantities of chert fragments. It grades into heavy sticky plastic mottled silty clay. Bedrock is at a depth of 10 feet or more.

Variations are due mainly to differences in the degree of accelerated erosion and in the quantity of chert. Some small areas in Cedar Fork Valley are much more cherty, less severely eroded, and slightly more productive than normal.

Use and management.—Neither its present use nor management are well adjusted to the physical character of Dewey silty clay loam, eroded hilly phase, but considerable variations are among the different farms in these respects. Practically all the soil has been cleared and cultivated, but at present about 25 percent is idle, 20 percent is used for corn, 40 percent for hay and small areas of wheat and tobacco, and 15 percent for pasture. A few farmers use a rotation of corn, small grain, and hay; but generally no definite cropping system is followed, and corn is grown for several years in succession followed by lespedeza hay or poor pasture. About 100 pounds an acre of 0-10-4, 0-16-0, or 0-20-0 commercial fertilizer is applied to the corn crop, and barnyard manure is used where available. Practically no fertilizer is used on other crops, and only a small area of the soil receives periodic lime applications. Specific practices for the conservation of moisture and control of erosion are not generally used; but tillage is on the contour in most places, largely from necessity. Under common management, yields of about 20 bushels of corn, 12 bushels of wheat, 400 pounds of tobacco, and $\frac{3}{4}$ ton of lespedeza hay to the acre are expected. Where lime is used in addition to other common management practices, yields of 2 tons of alfalfa and 1 ton of red clover may be obtained.

Good management requirements are based chiefly on the needs for preventing further erosion, improving the physical condition of the surface soil, and improving moisture conditions for crops. Practices for increasing the supplies of humus and nitrogen and supplying phosphorus and probably potash are also required. Legumes, as alfalfa and red clover, and sod-forming grasses should be grown during much of the rotation, as they are effective both in runoff control and in increasing the organic-matter and nitrogen contents. A year of corn followed by wheat will complete a desirable 7-year rotation. Barnyard manure is effective in supplying nitrogen and improving tilth and moisture conditions for crops; it also furnishes some potassium but additional supplies from commercial fertilizers are possibly needed. Lime, together with liberal phosphorus applications, is necessary for good growth of legumes and will give increased yields of other crops. Although runoff should be controlled largely by proper choice and rotation of crops and judicious use of amendments, other control measures may be necessary. Contour tillage should be practiced, and, where row crops are grown, strip cropping may be practicable on the longer slopes. Terracing is feasible from an engineering standpoint in very few places, but gullies may be controlled by check dams and plantings of forest trees.

Dewey silty clay loam, eroded steep phase.—Small areas of this soil occur in the limestone valleys on short steep slopes of 30 percent or more. It is on well-drained uplands underlain by high-grade or

slightly cherty limestone. Surface drainage is very rapid and internal drainage moderate. Native vegetation was a deciduous forest of oak, hickory, maple, black walnut, and possibly cedar. Only 203 acres are mapped.

The profile of this soil is similar to that of the eroded hilly phase, but more of the original surface layer has been removed by erosion and the other layers are somewhat thinner. In most places the original surface soil is missing and the tilled soil is the upper part of the original subsoil. The 18- to 30-inch subsoil is a red silty clay with a nut structure. It is sticky and plastic when wet but moderately friable when moist, although the upper part that is tilled may be hard and intractable. Reaction is strongly acid. It is low in organic matter because of loss of material by erosion, but the supply of mineral plant nutrients is high in comparison with that of other soils on similar slopes. Good tilth is difficult to maintain in the plow layer because of heavy texture. A moderate quantity of chert is on the surface and in the soil. Bedrock outcrops are in some places, and loose fragments of limestone rock may be on the surface. The subsoil is underlain by heavy sticky plastic mottled silty clay that is dominantly red in color. Massive limestone bedrock, which is slightly cherty in many places, is at a depth of about 10 feet.

Use and management.—In the past Dewey silty clay loam, eroded steep phase, was used for purposes for which it was not physically well suited. Practically all of it had once been cleared and used for growing tilled crops, but most of it is now abandoned. Some areas have pasture of poor quality but much of it is second-growth forest, chiefly Virginia pine.

Although this soil is similar to the eroded phase, the requirements for use and good management are quite different because of the steeper slopes and greater degree of erosion. Where used for tilled crops, this soil cannot be conserved, and its best use is for either pasture or forest. Management requirements on pastures include preventing further erosion, conserving moisture, increasing the nitrogen content, and supplying lime, phosphorus, and potash.

Good stands of legumes and sod-forming grasses can be established by the application of lime and phosphorus. These crops will be effective in increasing the humus content and the moisture-holding capacity, thereby decreasing runoff. Their root mat holds the soil in place and prevents loss of material by erosion. Terracing is probably not feasible, but the few required tillage operations should be on the contour. The more seriously eroded areas are possibly best suited to forest, but before trees are planted gullies should be controlled by check dams. Moderate applications of phosphate fertilizers are effective in obtaining vigorous growth of young trees, especially black locust. Young forests should be carefully protected from fire and from grazing by livestock.

DUNNING SERIES

The soil of the Dunning series is on level poorly drained bottom lands in association with the Melvin and Lindsides soils. It is underlain by heavy limestone material and is the heaviest textured and darkest colored soil on the bottom lands. It is a moderately fertile,

slightly to medium acid soil, that is generally good pasture land but is poorly suited to crops.

The surface layer is a heavy nearly black silty clay loam, and the subsoil is a gray heavy sticky plastic silty clay containing some yellow and brown mottlings. Limestone bedrock lies at variable depths. Use and management requirements are similar to those for the Melvin soil. Only one type, the silty clay loam, is mapped.

Dunning silty clay loam.—This poorly drained soil is on nearly level bottom lands underlain by heavy alluvium washed largely from uplands underlain by limestone. Some shale material may be present. In spring the soil is subject to overflow, and both internal and surface drainage are very slow. Small areas are on slopes of less than 2 percent along the small creeks in Powell and Cedar Fork Valleys and the valley of Little Sycamore Creek in association with Melvin and Lindsides soils in the creek bottoms. Talbott and Colbert soils are on the adjoining uplands. Native vegetation was a hardwood forest.

The surface 8 to 12 inches is heavy almost black silty clay loam. It is sticky and plastic when wet and hard and intractable when dry, and most of it has a very distinct nut structure. Organic-matter content is high, and reaction is medium acid to neutral. Moisture moves very slowly through the soil; during rainy seasons it is saturated with water, but in periods of low rainfall it becomes very dry and hard. Because of the heavy texture and unfavorable moisture conditions it is very difficult to work, and good tilth is very difficult to maintain. Small slabs of limestone are on the surface in places.

The subsoil is heavy sticky plastic silty clay, dominantly gray in color but heavily mottled with brown and yellow. This layer is 2 to 3 feet thick and is underlain by stream alluvium washed from limestone uplands. It is ordinarily less heavy and compact than the overlying subsoil. Limestone bedrock is at depths of several feet. No significant variations are included.

Use and management.—The present use and management of Dunning silty clay loam are essentially the same as those for Melvin silt loam.

EMORY SERIES

The Emory soil is on gently sloping benches and in the bottoms of large lime sinks in the cherty ridge sections and limestone valleys. The parent material of colluvium and local alluvium is washed and rolled largely from upland slopes covered with the Bolton, Claiborne, and Dewey soils. Excellent tilth is easily maintained. None of the soil is eroded, and none is susceptible to erosion. It is practically free of stone or chert. One type, the silt loam, is mapped.

Emory silt loam.—This well-drained soil is on foot slopes and benches along intermittent streams in the cherty ridge sections and to a lesser extent in the limestone valleys. Its parent materials are colluvium and local alluvium that have rolled and washed from the adjoining uplands. The slopes are predominantly gentle and range from 2 to 10 percent. Native vegetation was a hardwood forest.

The largest proportionate area is in the general vicinity of Clouds, Goins, Sandlick, and New Tazewell. It is in long narrow strips along

intermittent streams, with Bolton and Claiborne soils on the adjoining uplands. In most places the soil occupies the entire area of colluvial land on which it is found, but in some places it may be associated with the Greendale soils. Small-sized areas are in Powell Valley, and the Dewey and Talbott soils are the associated upland soils.

This young soil does not have a well-developed profile and varies in characteristics from place to place according to the nature of the adjoining upland and the manner of deposition of the soil material. In general the surface 12 to 18 inches is friable brown heavy silt loam with a granular structure. As compared with the upland soils humus and nitrogen supplies are relatively high and potash and phosphorus contents are higher. Reaction is slightly to medium acid. Moisture conditions are favorable for plant growth; the soil is permeable to moisture but has a high moisture-holding capacity. Excellent tilth is easily maintained, and tillage operations can be easily accomplished over a fairly wide range of moisture conditions. In some places some angular chert fragments are on the surface and in the soil.

The yellowish-brown subsoil is a friable heavy silt loam or silty clay loam with a crumb structure. Small dark-brown concretions and some small chert fragments are present. This layer is 2 to 3 feet thick in most places and is underlain by brownish or reddish colluvial materials containing some fine chert fragments. Limestone or dolomite bedrock is at depths of many feet.

No significant variations of this soil are mapped.

Use and management.—Although the present use and management of Emory silt loam are fairly well adjusted to the physical properties of the soil, productivity can be increased by improved management in most places. All the soil is cleared and under cultivation; about a third is used for corn, a third for tobacco, 10 percent for small grain, and most of the rest for hay, pasture, and small acreages of potatoes and other vegetables. In contrast with the adjoining upland soils, practically none of the soil is idle during a crop season. Lespedeza, red clover, and timothy are the chief hay crops. A few of the better farmers use a rotation of a row crop followed by small grain seeded to hay, which is allowed to remain 1 or 2 years. In many places no systematic rotation is used, and tobacco or corn may be grown for several years in succession followed by small grains or hay.

Very little of the soil is ever limed. Most farmers fertilize tobacco with moderate to large quantities of complete fertilizers, and corn with small quantities of fertilizer. Hay crops ordinarily receive no amendments. Tillage operations are carried out with greater care and more promptness than on the adjoining upland soils, largely because this soil is more productive and more responsive to good management. Under prevailing systems of management, average yields of about 50 bushels of corn, 20 bushels of wheat, 1,500 pounds of burley tobacco, 1½ tons of lespedeza, 1¾ tons of red clover, and 3 tons of alfalfa to the acre may be expected.

Although this soil is productive in its present condition, it is responsive to improved management practices. Increased yields can be obtained by the proper choice and rotation of crops and the use of fertilizer and soil amendments. No special problems of water control either in regard to drainage or prevention of erosion are present. Accelerated erosion, however, should be prevented on the

adjoining upland slopes in order to protect this soil from overwash by heavy subsoil material.

The soil is suited to intensive use, and if it is well managed, row crops can be grown in alternate years. A row crop should be followed by small grain which is seeded to crimson clover early in fall after the small grain is harvested. The crimson clover forms a winter cover crop and can be turned under in spring as a green manure. It increases the humus content and the nitrogen supply, thereby improving tilth, moisture conditions, and soil fertility. Under such a system of management, nitrogen fertilizers should not be necessary on corn, but moderate to large quantities of phosphorus and potash should be applied. Where tobacco is grown, moderate or large quantities of complete fertilizer high in phosphorus and potash are needed. Small grains also should receive moderate quantities of similar fertilizers, but the potash content can be lower. Part of the soil probably needs lime, but much of it is nearly neutral in reaction. Chemical quick-tests are useful in determining whether or not lime is needed.

ETOWAH SERIES

The soil of the Etowah series occurs on terrace benches along the small streams in limestone valleys. The parent material was derived from old stream alluvium washed largely from uplands underlain by limestone. All the soil is in Powell Valley well above the present level of stream overflow. Relief ranges from gently to strongly sloping and erosion from moderate to severe.

The soil has a well-developed profile. The grayish-brown or light-brown silt loam surface soil is underlain by a brownish-red silty clay loam subsoil. The substratum is brownish or yellowish alluvium containing rounded gravel and chert fragments. At variable depths it is underlain by limestone residuum or limestone bedrock.

Although the soil is at least fairly well suited to crops, good yields require the use of lime, fertilizer, and erosion control measures. The eroded phase of the silty clay loam is the only type mapped.

Etowah silty clay loam, eroded phase.—Small areas of this soil occur on nearly level to sloping well-drained terrace benches well above the present level of stream overflow. The parent materials were derived from old alluvium washed largely from uplands underlain by limestone. About two-thirds of the soil has slopes of 2 to 5 percent, and the rest of 5 to 12 percent. Both surface and internal drainage are moderate, although surface runoff may be somewhat rapid on the steeper areas. The soil is along the small streams in Powell Valley in association with the Dewey and Talbott soils and Rolling stony land (Talbott soil material) on the adjoining valley uplands and with Lindside and Melvin soils on the adjacent stream bottom lands. Native vegetation was a hardwood forest of oak, hickory, yellowpoplar, maple, walnut, and dogwood.

The original 10- to 12-inch surface layer was a grayish-brown or light-brown friable silt loam with a fine crumb structure. Much of it has been lost by erosion, and, at present, the plow layer consists of the remaining few inches mixed with the upper part of the original subsoil. This material is somewhat sticky and plastic when wet and hard when dry. It is low in organic matter and medium to strongly acid in

reaction. Good tilth is difficult to maintain because of the eroded condition. The soil becomes puddled or cloddy if plowed when too wet or too dry. Favorable moisture conditions are fairly easily maintained, although the loss of water through surface runoff may be great.

The 18- to 24-inch subsoil is brownish-red silty clay loam with a fairly well-developed nut structure. It is moderately friable when moist but becomes sticky and plastic when wet. In most places it contains small dark-brown concretions in the lower part. It is underlain by brownish or yellowish old stream alluvium containing some sand and gravel. Limestone residuum or limestone bedrock is at depths of several feet below the surface.

No significant variations other than those caused by differences in slope and erosion are included.

Use and management.—The present use of Etowah silty clay loam, eroded phase, is fairly well adjusted to its physical character, but management practices designed to conserve or improve the soil are not ordinarily used. Practically all the soil is cleared and cultivated, chiefly to corn, hay, and tobacco. Crops are not ordinarily rotated. Lime, fertilizer, and other soil amendments are used in relatively small quantities or not at all, and special practices for preventing erosion are not generally used. Under prevailing systems of management, yields of about 25 bushels of corn, 750 pounds of burley tobacco, and 1 ton of lespedeza hay to the acre may be expected.

Requirements for good management center about proper choice and rotation of crops, correct use of soil amendments, and control of runoff so as to improve tilth and moisture conditions, increase organic-matter and nitrogen contents, and prevent erosion. These requirements are similar to those for Dewey silty clay loam, eroded phase.

FULLERTON SERIES

Soils of the Fullerton series are on the high round-topped cherty ridges in association with the Clarksville, Claiborne, and Bolton soils. They developed under a mixed hardwood forest. Their red heavy silty clay parent material was weathered from cherty dolomite. Slopes vary greatly; 16 percent of the soils are rolling; 39 percent, hilly; and 45 percent, steep. This is the most extensive series in the county, covering about 26 percent of its area.

These soils are lighter in color and more cherty than either the Bolton or Claiborne soils. They have a friable gray or brownish-gray silt loam or loam surface layer about 8 to 12 inches thick and a yellowish-red or light-red silty clay loam or clay loam subsoil containing a relatively large quantity of chert. Cherty dolomite bedrock is at a depth of 30 feet or more.

On 85 percent of these soils there is sufficient chert on the surface and in the soil to interfere materially with cultivation. About 50 percent of the soils have been eroded enough to reduce their fertility, impair their workability, and increase their requirements for conservation. Their large acreage and wide distribution, however, place them among the most important agriculturally on the uplands. They are suited to a variety of uses and are variable in management needs because of differences in slope, chertiness, and erosion. Areas with rolling relief are at least fairly well suited to use as cropland; the hilly

phases are best suited to pasture, and the steep phases to forest. All these soils are acid and low in lime, humus, and mineral plant nutrients. Where they are used for growing crops or pasture, management practices should increase the humus supply and supply lime, phosphorus, potash, and nitrogen. The stronger slopes require special measures for conservation of soil moisture and prevention of erosion. If good management is practiced on the areas suited to crops, moderate crop yields of good quality can be expected in normal seasons. Four types and eight phases are mapped—the cherty loam, the cherty silt loam, the loam, the silt loam, and the hilly and steep phases of each type.

Fullerton cherty loam.—This soil is on upland ridges underlain by cherty dolomite of the Copper Ridge and Beckmantown formations that contain thin layers of sandstone. Slopes range from 5 to 12 percent. External drainage is moderate and internal drainage somewhat rapid. Native vegetation was a mixed forest of oak, hickory, blackgum, sourwood, dogwood, and shortleaf pine. Irregularly shaped areas of small or medium size or of long narrow strips are in all the cherty ridge sections underlain by sandy dolomites, but the largest proportionate acreages are in a broad belt extending from Tazewell northward to the county line and in the general vicinities of Sandlick, Goins, and Clouds. An aggregate area of 2,170 acres is mapped, chiefly in association with other Fullerton loam soils, but also with Claiborne or Bolton soils, especially on the adjoining north- and east-facing slopes.

The profile is similar to that of Fullerton loam, but the surface soil is somewhat lighter in color, is more sandy, and contains more chert fragments. The 6- to 10-inch surface layer is gray or light-gray loose cherty loam to fine sandy loam. In some places where nearly all the fine soil material has been lost by erosion, the present surface layer is largely a mass of angular chert fragments. The organic-matter content is very low because of cropping and erosion. Reaction is strongly or very strongly acid. Soil moisture, air, and plant roots move freely, and the water-holding capacity is low because of the large proportion of coarse materials; crops, consequently, are severely injured by prolonged droughts. Because of the large quantity of chert workability is poor and cannot be materially improved by practical means.

The light yellowish-red subsoil is firm but moderately friable cherty sandy clay with a weakly developed nut structure. It is about 30 inches thick and grades into cherty red clay mottled with gray, brown, and yellow. Cherty dolomite bedrock containing thin layers of sandstone is at depths of 20 to 50 feet or more.

Variations are due to differences in thickness and chertiness of the surface soil caused by losses of soil material through erosion. As with other Fullerton soils, the boundary between this and other soils is not clear or the change may be gradual over a considerable area so that some small areas of other Fullerton soils are included. In other places, areas of other types and phases are included because they are too small to delineate on the map of the scale used.

Use and management.—The present use of Fullerton cherty loam is fairly well adjusted to its physical properties, but management is at a low level and few practices designed to compensate for soil

deficiencies are used. No attempt is made to conserve soil moisture and prevent erosion. About 25 percent of the soil is in forest; 25 percent in corn; 30 percent in hay and pasture; and most of the remaining 20 percent in idle land, with small acreages of tobacco, small grains, fruits, and vegetables. Systematic crop rotation is not practiced, and in most places the crop grown in a particular field is determined by the immediate needs of the farm owner or operator. Corn is grown for 1 or 2 years after which the soil is idle for several years and the weeds, broomsedge, and brush that grow are removed by burning before another corn crop is planted. Some of these fields are used for pasture, but many are idle. Lespedeza is the chief hay crop, but some redtop and timothy are also grown. With the exception of small applications of fertilizer on corn, farmers do not use soil amendments. Under prevailing systems of management, acre yields of about 15 bushels of corn, 650 pounds of burley tobacco, and about $\frac{3}{4}$ ton of lespedeza or mixed hay are obtained.

Where the soil is used for cropland, several special management requirements—including proper choice and rotation of crops, use of lime and fertilizer, and measures for conserving moisture and preventing erosion—are required. Management practices for Fullerton cherty silt loam are applicable on this soil. Some soil areas are so cherty and stony that they are suited to neither crops nor pasture but should be in forest. Cleared tracts should be reforested by natural reproduction from adjoining woodlands or by systematic planting of suitable tree species.

Fullerton cherty loam, hilly phase.—An aggregate area of 6,514 acres of this phase is mapped in irregularly shaped areas of medium size on the upper ridge slopes associated chiefly with other loam soils of the Fullerton series but also with Claiborne and Bolton soils.

The soil has developed from parent material weathered from cherty sandy dolomites of the Copper Ridge and Beekmantown formations under a mixed forest chiefly of oak, hickory, blackgum, dogwood, and probably shortleaf pine. Slopes range from 12 to 25 percent, and both internal and surface drainage are rapid. Like the other Fullerton loams, the largest proportionate acreages are in the general vicinities of Goins, Clouds, Sandlick, and in a broad area extending from Tazewell northward to the county line.

The profile is similar to that of the normal phase, but the various layers may be somewhat thinner in all places and where cleared a larger part of the original surface soil has been lost through erosion. Under forest the surface 8 to 10 inches is cherty gray loose loam to fine sandy loam, but where cleared, most of this layer is missing and the present surface is largely a mass of angular chert fragments or cherty material of the original subsoil. The original content of humus was low, and most of it has been lost through erosion and cropping. In most places reaction is very strongly acid. Tillage is difficult because of the strong slopes, large quantity of chert, and heavy soil material. The low water-holding capacity, poor absorptive properties, and rapid runoff create poor moisture conditions for plant growth except in the most favorable seasons. Large loose sandstone and chert boulders are plentiful in many places in the forested areas.

The subsoil is yellowish-red cherty fine sandy clay loam with a weakly developed nut structure. It is about 2 feet thick and grades

into red cherty clay or sandy clay with a well-developed nut structure. Cherty sandy dolomite bedrock is at depths of 20 feet or more in most places, but ledges outcrop on the surface in a few places.

The principal variations are due to differences in erosion and the quantity of chert present. As with other Fullerton soils, some areas of another type or phase of the series may be included, either because the boundaries were indistinct or because the areas were too small to delineate on the scale of the map.

Use and management.—Where cleared, the present management of Fullerton cherty loam, hilly phase, is poorly adjusted to soil conditions, and forests generally are not well managed. About 40 percent of the soil is in forest, 15 percent in corn, 10 percent in hay, and 35 percent in idle land or poor pasture. The general management system is very similar to that for Fullerton cherty silt loam, hilly phase, and expected yields will be the same or slightly less.

Because of the low fertility, poor moisture conditions, poor workability, and poor conservability, this soil is not suited to growing crops. Although it is not well suited to pasture, scarcity of good land necessitates such a use. In some places, however, soil conditions are so unfavorable that pastures will not yield sufficiently to bring profitable returns. Most of the soil now in forest should remain in forest, and part of the area now cleared should be reforested.

Fullerton cherty loam, steep phase.—This phase is on steep slopes underlain by cherty sandy dolomites of the Copper Ridge and Beekmantown formations. Slopes range from 25 to 50 percent, but are mostly 30 to 40 percent. Internal drainage is moderate and external drainage, very rapid. Native vegetation was a mixed forest chiefly of oak, hickory, blackgum, dogwood, and sourwood; but nearly pure stands of shortleaf pine were in some places. A total of 10,803 acres is mapped, chiefly on steep slopes along the Powell River and its tributaries. Most of it is in the northeastern part of the county and in the vicinities of Clouds and Goins in relatively large areas associated with other steep phases of Fullerton and Clarksville soils on the uplands and with Greendale soils on the adjacent colluvial lands.

The profile is similar to that of the hilly phase, but the soil layers may be somewhat thinner and where cleared more of the surface soil material has been lost by erosion. Under forest, the surface 8 inches is loose gray cherty loam to cherty fine sandy loam. It is strongly acid in reaction and relatively low in organic matter. Roots, water, and air circulate freely, but moisture conditions for plant growth are only fair because of the large loss of water through runoff. In many places large chert and sandstone boulders are on the surface. Where cleared, most of the original surface layer is missing, and the present surface soil is largely a mass of chert fragments mixed with subsoil material. In these places, conditions for the growth of either crop or pasture plants are very poor because of low humus content, extreme acidity, very low fertility, and extremely poor moisture relations.

The subsoil is yellowish-red or red cherty clay loam with a weakly developed nut structure. It is about 2 feet thick and grades into red clay or sandy clay with a well-developed nut structure. Half or more of the volume of these layers is angular chert fragments. Sandy dolomite bedrock is at depths of 10 feet or more in most places, but surface outcrops are in many places, especially along the lower slopes.

Other than the variations in the soil caused by erosion, the chief variations are due to the inclusion of small areas of other steep phases of Fullerton and Clarksville soils because of indistinct soil boundaries or because the areas are too small to delineate on the scale of the soil map.

Use and management.—The present use of Fullerton cherty loam, steep phase, is fairly well adjusted to its use capability, but management is at a low level everywhere. At present about 80 percent of the soil is in forest and 20 percent is cleared. Corn and hay are the chief crops. Management practices similar to those for Fullerton cherty silt loam, steep phase, are commonly used and comparable yields are obtained. In forests no special measures for conservation or improvement of timber stands are used.

Requirements for good use and management are concerned chiefly with the use and management of forests; for the soil is very poorly suited either to crops or pasture because of steep slopes, chertiness, natural poverty in plant nutrients, and poor moisture conditions. Pasture and crops can be produced, but management requirements are so exacting and costly that such uses are not practical under present conditions; therefore, where the soil is in forest it should remain in forest, and cleared areas should be reforested.

Fullerton cherty silt loam.—This soil occurs on ridge crests underlain by cherty dolomites of the Copper Ridge and Beekmantown formations in association chiefly with other types and phases of Clarksville and Fullerton soils. Slopes range from 5 to 12 percent, and both surface and internal drainage are moderate. The total area mapped is 5,842 acres. Part of the soil is in large irregular-shaped broad areas on the ridges on the north side of Cedar Fork Valley east of Tazewell; but most of it is in long narrow strips on cherty ridge crests and is throughout all the cherty ridge sections of the county.

Bolton or Claiborne soils may be on some of the adjoining steep slopes, especially the north- and east-facing ones. Native vegetation was a hardwood forest of oak, hickory, blackgum, sweetgum, and dogwood.

The profile is similar to that of Fullerton silt loam, but more chert is on the surface and in the soil. Under forest the surface 10 to 12 inches is loose cherty gray light silt loam; but where cleared, part of this layer has been lost by erosion. In most places, however, enough remains to form the plow layer, and the subsoil is not ordinarily turned by tillage operations. The soil is strongly acid in reaction and low in humus, lime, and plant nutrients. It is permeable to water, roots, and air; but because of the large quantity of chert on the surface and in the soil it is moderately difficult to work. Water is absorbed readily, and the loss of soil material by erosion is probably less than from Fullerton silt loam.

The subsoil is light yellowish-red cherty silty clay loam with a well-defined nut structure. It is somewhat hard and friable when dry, sticky and plastic when wet, and moderately friable when moist. Roots, air, and moisture move freely. Reaction is very strongly acid. This layer is about 24 inches thick and grades into heavy red silty clay mottled with yellow, brown, and gray. In many places one-half or more of the volume of material in this layer is angular chert frag-

ments of 1 to more than 8 inches in size. Cherty dolomite bedrock is at depths of 30 to 50 feet or more.

Significant variations are those due to differences in chertiness and texture. In some places the fine soil material has been lost from the original surface layer by accelerated erosion, and the present surface soil consists largely of a mass of angular chert fragments. This variation is not of large extent and has been indicated on the soil map by symbols in the delineated soil area. A few small areas on the tops of low hills along the southeast side of Powell Valley have a heavy subsoil similar to that of the Talbott soils. Small areas of Clarksville soils may be included in this mapping separation, where such areas are too small to delineate on the map or where the boundary between the two soils is not clear.

Use and management.—The present use of Fullerton cherty silt loam is fairly well adjusted to its physical characteristics. Management practices are seldom designed to compensate for soil deficiencies. Only a small part of the soil is limed at regular intervals, and practically no special practices for controlling runoff and preventing erosion are used. About 15 percent of the soil is now in forest, 20 percent in corn, 15 percent in small grains, 10 percent in hay, 15 percent in pasture, 5 percent in tobacco and vegetables, and 20 percent in idle or fallow land.

As with most other Fullerton soils, crop rotation is not generally practiced; but a few farmers use a rotation of a row crop followed by small grain seeded to hay, usually lespedeza. In many places, corn may be grown for several years in succession, after which the soil is allowed to lie idle for several years until it is again needed for crops. Lespedeza is the most common hay and pasture crop, but some timothy and redtop are also grown. Corn and wheat are fertilized with about 100 pounds of 0-10-4 fertilizer, but no fertilizer is ordinarily used on hay and pasture. Tobacco receives heavy applications of complete fertilizers, or, where it is available, barnyard manure and superphosphate. Under prevailing management, average acre yields of about 18 bushels of corn, 10 bushels of wheat, 900 pounds of burley tobacco, and $\frac{3}{4}$ ton of lespedeza hay may be expected. Where lime is used in addition to other common practices, about 1 ton of red clover and $1\frac{1}{2}$ tons of alfalfa to the acre may be obtained.

Requirements for good management are similar to those for Fullerton silt loam. They are concerned chiefly with proper choice and rotation of crops, use of soil amendments, and practices for improving workability. The soil can be conserved under a rotation including a row crop once in 4 years if other management requirements are met. A row crop followed by small grain seeded to a legume or grass makes a desirable rotation. Corn, burley tobacco, soybeans, cowpeas, wheat, barley, oats, tomatoes and other vegetables, lespedeza, red clover, timothy, and redtop are among the crops suited to the soil. Fruit trees may be expected to do well if properly cared for. Legumes should have a prominent place in the rotation, inasmuch as they are effective in increasing the humus supply—thereby increasing nitrogen and improving tilth and moisture conditions.

All crops require liberal applications of fertilizers. Corn, small grains, and grasses require complete fertilizers containing moderate quantities of nitrogen and potash and large quantities of phosphorus. Tobacco and vegetables have similar needs, but the proportion of pot-

ash should be somewhat higher. Legumes require large quantities of both phosphorus and potash but ordinarily no nitrogen. Lime is necessary to establish and maintain stands of legumes, and it increases yields of other crops. Contour tillage can be practiced where practicable as an aid to conserving moisture and preventing erosion, and strip cropping also may be useful, especially on the longer slopes. Terraces may be beneficial in some places; but they must be carefully planned, constructed, and maintained to be effective.

Fullerton cherty silt loam, hilly phase.—This phase is on slopes of ridges underlain by cherty dolomites of the Copper Ridge and Beekmantown formations. The total of 16,639 acres occurs in irregularly shaped areas of medium or large size associated with other Fullerton soils and Clarksville soils in the uplands and with Greendale soils in the floors of the adjoining lime sinks. The soil also is throughout all the other cherty ridge sections of the county; where it is in areas of variable size and shape on slopes along intermittent streams in association with other Fullerton, Claiborne, and Bolton soils. Slopes range from 12 to 25 percent. Internal drainage is moderate and external drainage, rapid. Native vegetation was a mixed forest of oak, hickory, blackgum, sweetgum, dogwood, and possibly some shortleaf pine. The largest proportionate acreages of the soil are in the central part of the county in a broad belt extending from Tazewell northward to the Powell River and in the general vicinities of Clouds, Goins, and Little Barren Church.

The profile is similar to that of the normal phase; but the various soil layers generally are less thick and, where cleared, a larger part of the surface soil has been lost by erosion. In many cleared areas much of the upper subsoil is turned by the plow and mixed with the remaining surface soil material. Under forest, the surface 8 to 10 inches is gray friable cherty silt loam with a fine crumb structure. The organic-matter content is relatively low; and when the soil is cleared, this small supply is rapidly dissipated through cropping and erosion losses. Reaction is strongly acid. Where used for crops, good tilth is moderately difficult to maintain, and soil moisture conditions are only fair owing to loss of water caused by the strong slopes and the low absorptive capacity of the present surface layer.

The subsoil is yellowish-red or light-red cherty silty clay loam with a well-developed nut structure. It is about 2 feet thick and grades into a mottled red silty clay with a well-developed nut structure. As much as half the volume of these layers may consist of angular chert fragments. Cherty dolomite bedrock is at depths of 20 feet or more.

The chief variations mapped are those having differences in the degree of accelerated erosion. In many places small areas of Clarksville cherty silt loam, hilly phase, are included either because they are too small to delineate on the soil map or because the boundary is not clear.

Use and management.—Where Fullerton cherty silt loam, hilly phase, is cleared, its present use and management are poorly adjusted to its physical properties. About 40 percent of the soil is in forest, 15 percent in corn, 10 percent in hay (pl. 7, B), 15 percent in pasture, and 20 percent in idle land, with small acreages of tobacco and small grains. Systematic rotation of crops is not commonly practiced—corn is grown for a few years until yields become unprofitable, and

the soil is then allowed to rest for several years or is abandoned. Lespedeza is the principal hay crop but some timothy and redtop also are grown. Most pastures are chiefly broomsedge, but some are lespedeza. Small quantities of commercial fertilizer are used on corn and small grains, but fairly heavy applications are used on tobacco. Very little of the soil is limed. Contour tillage is practiced in many places, but no other special practices for erosion control are used. Average yields that may be expected under common management are about 13 bushels of corn, 8 bushels of wheat, 450 pounds of burley tobacco, and less than $\frac{3}{4}$ ton of lespedeza or mixed hay to the acre.

Management requirements vary according to the use of the soil. Where cropland is scarce and the soil must be used for crops, careful management is needed. Practices similar to those for Fullerton silt loam, hilly phase, are required—proper choice and rotation of crops, use of soil amendments, control of runoff, prevention of erosion, and conservation of soil moisture are needed. Wherever it is feasible, however, the soil is best used for pasture because of the relatively low fertility, poor moisture conditions, poor workability, and poor conservability.

Bluegrass, white clover, orchard grass, redtop, lespedeza, hop clover, bur-clover, and Bermuda grass are suitable for pasture. A mixture of bluegrass and legumes makes pastures of the best quality and highest carrying capacity. Moderate to heavy applications of phosphorus are necessary, and potash is possibly needed. Soil acidity can be corrected by lime.

On some of the more severely eroded areas under proper management, pastures of Bermuda grass and lespedeza may improve soil conditions so that better pastures may be established. Clipping of pastures may be necessary to control weeds. Grazing should be carefully controlled, especially during periods of adverse moisture conditions, to prevent injury to pasture stands and to prevent erosion. Gullies should be stabilized by check dams and tree plantings; thin shading by widely spaced locust trees may be beneficial, especially where bluegrass is grown. Much of this soil is far from springs or flowing streams, and furnishing water to livestock on pastures is a serious problem. Ponds or reservoirs for collecting and storing rain are necessary in many places, whereas piping water from springs, wells, or cisterns may be practical in others.

Fullerton cherty silt loam, steep phase.—Areas of this phase are on steep slopes of ridges underlain by cherty dolomites of the Beekmantown and Copper Ridge formations. Relief ranges from 25 to 50 percent, slopes from 30 to 40 percent gradient being commonest. Internal drainage is moderate and external drainage, very rapid. As on other Fullerton soils, native vegetation was a mixed forest of oak, hickory, sweetgum, blackgum, and dogwood, and possibly shortleaf pine in some places. The soil is chiefly adjacent to the Powell River and its tributaries, but it is throughout all the cherty ridge sections of the county. It is in relatively broad, long, continuous strips in large areas associated chiefly with other Fullerton soils and Clarksville soils on the ridges and with Greendale, Sequatchie, and Roane soils in the adjoining colluvial lands, terrace lands, and bottom lands. Small areas are associated with Bolton or Claiborne soils on the steep slopes

at the heads of intermittent drains. A total area of 20,265 acres is mapped.

The profile is similar to that of the normal phase, but the thickness of the various layers may be somewhat less. Under forest, the surface 8 to 10 inches is gray friable cherty silt loam with a fine crumb structure. The upper few inches contains a small or medium quantity of humus. Where cleared, this layer is entirely missing in most places, and the upper part of the original subsoil now forms the surface layer. In such places, the content of organic matter is very low, good tilth is maintained with difficulty, and soil moisture conditions are poor for plant growth. The surface layer is very cherty because of the removal by erosion of the fine soil material in the original surface soil. Reaction is strongly to very strongly acid.

The subsoil is light-red or yellowish-red cherty silty clay loam with a well-developed nut structure. It is about 2 feet thick and grades into mottled red silty clay with a coarse nut structure. More than half of these layers is angular chert fragments ranging in size from 1 to 10 inches or more. Cherty dolomite bedrock is at depths of 10 feet or more; but the rock floor is somewhat jagged and uneven, and bedrock outcrops on the surface in some places, especially near the foot of slopes.

The chief variations mapped are in the degree of accelerated erosion and the quantity of chert on the surface and in the soil. Small areas of Clarksville cherty silt loam, steep phase, or Claiborne silt loam, steep phase, are included in this mapping separation because they are too small to delineate separately on the soil map or because the boundaries between the soils are not clear.

Use and management.—The present use and management of Fullerton cherty silt loam, steep phase, vary from place to place. About 60 percent of the soil is in forest; 30 percent in pasture; and 10 percent in crops, including corn and hay. Corn is grown for 1 or 2 years, and the soil is then allowed to rest or is abandoned for several years. During this time a sod of broomsedge and other wild grasses and brush becomes established. In some places these fields are idle or wasteland; but others are used for pasture, and, in a few places, lespedeza may be sown for hay or pasture. Soil amendments are not ordinarily used on corn, hay, or pasture. The system of growing row crops at intervals interspersed with several years of idleness or poor pasture soon depletes the soil, making it of little use to the farmer. Fields are abandoned to second-growth forest, but in general the forest is not well managed. Selective cutting is not practiced, and ordinarily the forest is not protected from fires or grazing.

Because of steep slope, chertiness, natural poverty in plant nutrients, and poor moisture conditions, this phase is very poorly suited either to crops or pasture. Management requirements for either would be so exacting and costly that the yields obtained probably would not return a profit; therefore the soil is best used entirely for forest. The use and management of forest lands is discussed in the section on Forests.

Fullerton loam.—This soil is on the crests of ridges underlain by cherty dolomite of the Copper Ridge formation containing layers of calcareous sandstones. An aggregate area of 1,008 acres is mapped, chiefly in small irregularly shaped areas or long narrow strips on the

ridge crests. It is associated chiefly with other Fullerton loams and Claiborne and Bolton soils. Slopes are 5 to 12 percent, and both external and internal drainage are moderate. The soil was developed under a mixed forest of oak, hickory, some chestnut, blackgum, sweetgum, dogwood, and some shortleaf pine. The largest acreages are in the general vicinities of Sandlick, Goins, Lily Grove School, and Clouds in the southwestern part of the county and around Bacchus School several miles north of Tazewell.

The soil profile is similar to that of Fullerton silt loam, but the texture of the upper layers is lighter. The surface soil is loose gray loam to fine sandy loam. Originally it was about 12 inches thick, but under cultivation part of it has been lost through accelerated erosion; in most places, however, enough remains to form the present plow layer. Much of the original organic matter has been dissipated through erosion losses and from cropping. Reaction is strongly acid. The soil is permeable to air, plant roots, and moisture; and moisture conditions for plant growth are generally fair, although crops may be more severely injured by droughts on this soil than on the silt loam type because of the lighter texture and the lower water-holding capacity. Good tilth is easily maintained, and tillage can be carried on over a fairly wide range of moisture conditions. A few fragments of angular chert and some fine sandstone fragments are on the surface and in the soil.

The subsoil is firm but moderately friable yellowish-red light silty clay loam with a well-developed nut structure. Fragments of chert and some pieces of sandstone are present. This layer is about 20 inches thick and grades into cherty red silty clay with a well-developed nut structure. It is mottled with gray, yellow, and red and contains small brown concretions in the upper part. Cherty sandy dolomite is at depths of 30 to 50 feet.

The chief variations included are those due to the indistinct boundary between this soil and the associated ones. Small areas of Fullerton and Claiborne silt loams or Clarksville loam may be included. In some places, the subsoil may be a fine sandy clay and may range from brownish red to bright red. The extent of these variations is small, and they do not affect the general use suitability or management requirements.

Use and management.—The present use of Fullerton loam is fairly well adjusted to its physical suitability, but management practices are not generally designed to compensate for soil deficiencies. Practically all the soil is cleared; about 30 percent is in corn, 25 percent in small grain, 20 percent in hay, 15 percent in tobacco and vegetables, and 10 percent in idle land.

A few farmers use a rotation of a row crop followed by small grain seeded to lespedeza, but systematic rotations are not commonly used. Corn, tobacco, and vegetables are grown in successive years, after which the soil remains idle for an extended period or is allowed to grow up to broomsedge and wild grasses, which are used for hay or pasture. Corn and small grains are fertilized lightly with an 0-10-4 mixture. Tobacco and vegetables receive moderate to heavy applications of a complete commercial fertilizer as 3-8-6. As much as a fourth of the soil is limed at periodic intervals. No special methods for controlling runoff and preventing erosion are ordinarily practiced. Under pre-

vailing management practices, yields of about 22 bushels of corn, 12 bushels of wheat, 850 pounds of burley tobacco, and 1 ton of lespedeza or mixed hay to the acre are obtained. Where lime is used in addition to other common practices, yields of about 1 ton of red clover and 2 tons of alfalfa are obtained.

Management requirements are similar to those of Fullerton silt loam—they are concerned chiefly with supplying lime, potash, and phosphorus and increasing humus and nitrogen. Practices for controlling runoff and preventing erosion also are needed. A 3- or 4-year rotation of a row crop seeded to small grain followed by a legume for hay or pasture is well suited to the soil. Corn, soybeans, small grains, burley tobacco, potatoes, sweetpotatoes, tomatoes and other vegetables, lespedeza, red clover, timothy, small fruits, and tree fruits also are suited.

Sod-forming legumes should have a prominent place in the rotation; for they increase the contents of humus and nitrogen, improve tilth, and increase the water-absorbing properties of the soil. Barnyard manure is useful in this respect and also furnishes some potash, but it should be supplemented with phosphorus in order to obtain the proper balance of plant nutrients. Fertilizers are required by all crops, but frequent small or medium applications during a rotation are more effective than one or two large applications. Corn and small grains require complete fertilizers containing medium quantities of nitrogen and potash and large quantities of phosphorus. Vegetables and burley tobacco need similar fertilizers, but the proportion of potash should be larger. Legumes require large quantities of both potash and phosphorus, but ordinarily they need no nitrogen. Applications of lime should be made, preferably immediately prior to seeding the legume. Contour tillage can be practiced as an aid in conserving soil moisture and preventing erosion. Strip cropping also may be useful; and carefully planned, constructed, and maintained terraces may be effective in some places.

Fullerton loam, hilly phase.—This phase differs from the normal phase principally in that it is on steeper slopes. It is moderately low in fertility, moderately difficult to work and to conserve, and is poor to fair cropland. Like other Fullerton soils, it was derived from similar parent material under a mixed forest of oak, hickory, blackgum, sweetgum, dogwood, and possibly shortleaf pine. Slopes range from 12 to 25 percent. Internal drainage is moderate and external drainage rapid. The soil occupies an area of 1,210 acres in all the cherty ridge sections of the county, but the largest proportionate acreages are in the vicinities of Goins and Clouds and in a broad belt extending from Tazewell northward to the Powell River.

The profile is similar to that of the normal phase, but, where cleared, more of the original surface soil has been lost by accelerated erosion. Under forest the surface 10 inches is gray rather loose loam to fine sandy loam, but in cleared areas this layer is 4 to 6 inches thick and there is some mixing of the remaining original surface layer and the upper subsoil. The present plow soil therefore may be somewhat heavier in texture than the original surface layer. Good tilth, however, is still fairly easily maintained; and roots, air, and moisture circulate freely. The water-absorbing and holding properties are low, and crops are injured more by droughts than on the comparable silt

loam phase. Reaction is strongly acid. The organic-matter content is relatively low in the virgin condition, and under cultivation this supply is soon depleted by cropping and erosion losses. Small fragments of chert and sandstone are on the surface and in the soil.

The subsoil is yellowish-red fine sandy clay with a weakly developed nut structure. In the lower part of the layer the color is somewhat darker and the texture is heavier. It is about 24 inches thick and grades into a yellowish-red silty clay mottled with red, yellow, gray, and brown with a well-developed nut structure. Both of these layers contain moderate quantities of small fragments of chert and sandstone. Cherty dolomite bedrock, containing layers of sandstone, is at depths of 20 to 50 feet.

The chief variations are those due to differences in the degree of accelerated erosion. In some places small areas of Fullerton silt loam, Claiborne silt loam, rolling phase, and Fullerton cherty loam are included in this mapping separation either because the areas are too small to delineate on the soil map or because the boundary between the soils is not sharp. None of these variations is of sufficient extent or importance to alter materially the use suitability or management requirements of the soil.

Use and management.—Present use and management are similar to those of Fullerton silt loam, hilly phase, and are not well adjusted to the physical properties of the soil. In general, management practices are not designed to correct deficiencies or to conserve the soil. About 25 percent of the soil is in forest, 15 percent in corn, 5 percent in small grains, 15 percent in hay, 20 percent in pasture, and 20 percent in idle land, with small acreages in tobacco and vegetables.

Systematic rotation of crops is not generally practiced. Corn is grown for 1 or 2 years, after which lespedeza is seeded or broomsedge and other wild grasses are allowed to become established. These fields are cut for hay, used for pasture, or allowed to lie idle until again needed for corn. Corn and wheat are fertilized lightly with an 0-10-4 fertilizer or superphosphate, but hay and pasture ordinarily receive no fertilizer. Where tobacco is grown, large quantities of complete commercial fertilizer are used. Very little of the soil receives lime. Contour tillage is practiced in many places, but other practices for controlling runoff and preventing erosion are not used. Under management commonly practiced, average acre yields of about 12 bushels of corn, 8 bushels of wheat, 600 pounds of burley tobacco, and less than $\frac{3}{4}$ ton of lespedeza or mixed hay may be expected.

The use suitability and management requirements are similar to those on the comparable silt loam phase. Where the soil is used for crops, management requirements are very exacting—they are centered about supplying lime, nitrogen, and mineral plant nutrients; increasing the organic-matter content; properly choosing and rotating crops; conserving soil moisture; and preventing erosion. As with the hilly phase of the silt loam, the steeper and more severely eroded parts cannot be conserved when used for crops and are best used only for pasture. The chief management requirements of pastures are concerned chiefly with supplying lime and plant nutrients and choosing suitable pasture plants.

Fullerton loam, steep phase.—Because of its small area of 437 acres and its limited use suitability this phase is an unimportant soil.

It is similar to the hilly phase, but it is on stronger slopes, and consequently is less fertile and more difficult to work and to conserve. It is physically poorly suited to crops, but if properly managed it is fairly well suited to pasture.

The soil is on steep slopes of 25 to 50 percent on cherty ridges. It was developed from parent material weathered from cherty sandy dolomite chiefly of the Copper Ridge formation under a mixed forest of oak, hickory, blackgum, sweetgum, and shortleaf pine. Internal drainage is moderate, but external drainage is very rapid. Most of the soil is in small or medium-sized irregularly shaped areas in the belt of cherty ridges extending from Tazewell northward to the Powell River. It is associated chiefly with other loam types and phases of Fullerton soils.

The soil profile is essentially the same as that of the hilly phase and similar variations in the mapping separation were allowed.

Use and management.—Present use and management of Fullerton loam, steep phase, are poorly adjusted to the physical suitability of the soil. The present practices used and requirements for good management are similar to those for the comparable silt loam phase.

Fullerton silt loam.—Widely distributed areas of this soil, totaling 2,317 acres, are in all the cherty ridge sections of the county. The soil was developed from parent materials weathered from cherty dolomites of the Copper Ridge and Beekmantown formations. Slopes are 5 to 12 percent, and both internal and external drainage are moderate. Long narrow areas are on ridge crests closely associated with other types and phases of Fullerton soils, soils of the Clarksville and Claiborne series, and to a lesser extent with Bolton soils. Native vegetation was a mixed forest of oak, hickory, sweetgum, blackgum, shortleaf pine, and dogwood.

This soil is darker in color and less cherty than comparable types or phases of Clarksville soils, but it is less favorable in these respects than Bolton or Claiborne soils. Where uneroded, the surface soil is light brownish-gray friable silt loam with a fine crumb structure. On most cleared and cultivated areas, part of the layer has been lost by erosion; but in nearly all places enough remains to form the plow layer and the subsoil is not ordinarily turned by tillage operations. Tillage can be accomplished over a wide range of moisture conditions without seriously impairing tilth. The original content of humus was probably relatively low, and most of it has been dissipated through cropping and by erosion losses. Reaction is strongly acid. The soil is permeable to soil moisture, air, and plant roots and is absorptive of water, making loss of moisture through surface runoff less severe than on the heavier limestone soils. Some angular chert fragments are on the surface and in the soil.

The subsoil is yellowish-red or light-red silty clay loam with a well-developed nut structure. It is somewhat hard and brittle when dry, sticky and plastic when wet, but moderately friable when moist. It contains a large quantity of angular chert fragments and is 2 to 3 feet thick. This grades into a heavy red or yellowish-red silty clay with a well-developed coarse nut structure. This material is very cherty and contains mottlings of gray, ocher, rust brown, and yellow. Cherty dolomite bedrock is at depths of 30 feet or more.

The principal variations are those due to the indistinct boundaries between this soil and some other type or phase of Fullerton soil. For example, in many places where this soil is adjacent to Fullerton cherty silt loam, the soil gradually changes from this type to that one over a considerable area. In such places the line between the two soils must be arbitrarily drawn somewhere in the transitional zone. Some small areas of cherty soil too small to delineate on the soil map are included in this mapping separation. Small areas of Fullerton loam are included where the boundary between this and the associated soil is not clear.

Use and management.—The present use of Fullerton silt loam is fairly well adjusted to its physical properties, but prevailing management practices are not designed to compensate for the soil deficiencies or to conserve it. At present practically all the soil is cleared; about 30 percent is in corn, 20 percent in wheat, 15 percent in burley tobacco, 20 percent in hay and pasture, 5 percent in fruits and vegetables, and 10 percent in idle or fallow land. A few farmers use a rotation of corn, small grain, and hay; but much of the soil is used for growing row crops for several years in succession followed by several years of idleness after the soil has been depleted.

Corn and small grains ordinarily receive about 100 pounds an acre of 0-10-4 fertilizer. Heavy applications of a complete commercial fertilizer are used under tobacco, and vegetables usually receive at least moderate applications of similar material. Where available, barnyard manure is used on all row crops. Hay and pastures are not ordinarily fertilized and only a small part of the soil is limed at periodic intervals. Some farmers practice contour tillage, but other special methods for controlling runoff and preventing erosion are not ordinarily used. Under these common management practices average yields of about 25 bushels of corn, 15 bushels of wheat, 900 pounds of burley tobacco, and 1 ton of lespedeza hay to the acre are expected. Where lime is used in addition to other common practices, about 1½ tons of red clover and 2 tons of alfalfa to the acre are obtained.

Several special management requirements that can be attained without difficulty center about supplying lime and mineral plant nutrients, increasing the supply of humus, and properly choosing and rotating crops. Special practices for runoff control also are needed. Tillage can be accomplished over a fairly wide range of moisture conditions without seriously impairing tilth. Where practical, all tillage operations should be on the contour. Carefully planned and constructed broad-base terraces may be effective in conserving moisture and preventing erosion if they are properly maintained.

A rotation including a row crop once in 4 years is well suited to the soil. Corn, small grains, lespedeza, red clover, timothy, tomatoes and other vegetables, and fruits may be expected to do well. The soil is especially well suited to growing burley tobacco, and crops of excellent quality are obtained; although yields are not so high as on soils of the limestone valleys. Alfalfa can be successfully grown, if the soil is limed and heavily fertilized. Legumes are effective in increasing the supply of humus and nitrogen, improving the tilth of the surface soil, and controlling runoff. Corn and small grains require large applications of phosphorus and moderate quantities of nitrogen and potash; whereas tobacco and vegetables need large applications of

both phosphorus and potash and small to moderate quantities of nitrogen where legumes are included in the rotation. These requirements can probably best be met by using complete commercial fertilizers.

Legumes require large quantities of both phosphorus and potash, but no nitrogen. Barnyard manure is effective in increasing the humus and nitrogen supplies and furnishing potash, but it should be supplemented with phosphate fertilizers to obtain a proper balance of plant nutrients. Lime is essential to legumes and also gives increased yields of other crops. It can best be applied immediately before the legume in the rotation is seeded.

Fullerton silt loam, hilly phase.—This phase is in the uplands on the slopes of cherty ridges underlain by folded and faulted dolomites of the Copper Ridge and Beekmantown formations. Much of the soil is in sections with karst topography, where the land surface is very irregular in conformation. It is in irregularly shaped tracts on the slopes around sink holes and is associated with Greendale soils in the lime sinks and other Fullerton soils on the uplands. In dissected sections, it is in comparatively large areas on the hilly slopes associated chiefly with other Fullerton soils but also with soils of the Clarksville, Claiborne, and Bolton series. Slopes range from 12 to 25 percent. Internal drainage is moderate and external drainage rapid. Native vegetation was a mixed forest of oak, hickory, sweetgum, blackgum, dogwood, and some shortleaf pine. The aggregate area mapped is 3,869 acres, the largest proportionate acreages of which are in the general vicinities of Tazewell, New Tazewell, Goins, and Clouds.

The profile is essentially the same as that of the normal phase, but more of the original surface layer has been lost through erosion. Where the soil is cleared, the surface 6 inches is gray or brownish-gray friable silt loam with a fine granular structure, but under forest this layer is 10 or 12 inches thick. Many small tracts have lost all the original surface layer, and the present plow layer is the upper part of the original subsoil. In such places the surface is hard when dry and sticky when wet and good tilth is maintained with difficulty, but the rest of the soil generally has favorable tilth. Reaction is strongly acid. The present organic-matter content is low because of losses from erosion and through cropping. The soil is moderately low in potassium, phosphorus, and nitrogen. It is permeable to moisture, air, and plant roots; but because of the stronger slopes and eroded condition it is less favorable than the normal phase. Loss of water through surface runoff is greater, and moisture conditions for plant growth are generally less favorable. Some angular chert fragments are on the surface and in the soil.

The subsoil is essentially identical to that of the normal phase. It is light-red or yellowish-red cherty silty clay loam with a well-developed nut structure. It is moderately friable when moist but somewhat sticky and plastic when wet; soil moisture and plant roots, however, easily penetrate it. This layer is about 2 feet thick and grades into mottled red very cherty silty clay with a very distinct coarse nut structure. Cherty dolomite bedrock is at depths of 30 feet or more.

The principal variations other than those caused by differences in erosion are due to differences in the texture of the subsoil and the indistinct boundaries between this soil and the associated soils. On the ridge slopes on the southeast side of Powell Valley many small areas

have a heavy-textured subsoil similar to that of the Talbott soils; otherwise these areas are similar to the normal soil, are suited to similar uses, and have similar management requirements. In many places the boundary between this phase and some associated Clarks-ville or Claiborne soil is not clear, and small areas of those soils are included in areas delineated in this mapping unit. This variation is especially common where the soil is immediately associated with the hilly phase of Fullerton cherty silt loam.

Use and management.—The present use and management of Fullerton silt loam, hilly phase, are not generally well adjusted to the physical properties of the soil. About 25 percent of the phase is in forest, 12 percent in corn, 5 percent in small grains, 12 percent in hay, 30 percent in pasture, and 16 percent in idle land. Systematic rotation of crops is not ordinarily practiced. Corn is grown several years in succession followed by lespedeza hay, pasture, or several years of idleness. Idle fields grow up to broomsedge, blackberry, persimmon, and sassafras, which are removed before the soil is again used for crops. Corn and small grain receive small applications of 0-10-4 fertilizer or similar materials, but hay and pastures are not ordinarily fertilized. Very little of the soil receives lime. From necessity much of the soil is tilled on the contour, and a few farmers have constructed ditches to remove excess water; but carefully planned special methods for controlling and conserving water and preventing erosion are not generally used. Under common systems of management, average yields of about 15 bushels of corn, 9 bushels of wheat, and $\frac{3}{4}$ ton of lespedeza or mixed hay to the acre may be expected.

Where used for cropland, good management requirements are concerned with supplying lime, nitrogen, and mineral plant nutrients; increasing the humus content; properly choosing and rotating crops; and conserving moisture and controlling erosion. When other management requirements are met, the soil can be conserved under a rotation including a row crop once in 6 years. Corn followed by a small grain seeded to legumes or grasses for hay or pasture is a desirable rotation.

Crops well suited to the soil are corn, soybeans, wheat, barley, oats, red clover, lespedeza, timothy, and redtop. Fruit trees also do well. Alfalfa can be grown but requires much phosphorus and potash. It and other legumes are effective in increasing the nitrogen and humus supplies and binding the soil mass so that absorption of water is increased and runoff and erosion are greatly reduced. Lime is required before the legume in the rotation is seeded in order to obtain a good stand and insure continued growth. Lime also increases the yields of other crops. Corn and small grains require moderate to large applications of complete fertilizers containing medium quantities of nitrogen and potash and large quantities of phosphorus.

Tillage can be accomplished over a fairly wide range of moisture conditions except where the soil is severely eroded. Contour tillage should be practiced wherever the soil is used for cropland. A system of strip cropping may be a practicable method of farming some of the longer slopes. Terracing seems to be impractical over much of the soil because of the strong slopes, but it may be useful in conserving moisture and preventing erosion in some places. Terraces, however, must be very carefully planned, constructed, and maintained to be effective.

Check dams and tree plantings are excellent means of stabilizing gullies.

Where the soil is severely eroded, it probably cannot be conserved if used for cropland and therefore is best used entirely for pasture. A bluegrass and white clover mixture is well suited, but applications of phosphorus, potash, and lime at intervals are required to establish and maintain the pasture. Lespedeza, orchard grass, redtop, and Bermuda grass also are suited, but they are generally less exacting in their requirements for amendments and produce pastures of lower quality.

Grazing should be carefully regulated during periods of extreme moisture conditions to prevent injury to the pasture stand. Weeds can be controlled largely through proper fertilization and controlled grazing, but clipping of pastures once or twice during each year may be necessary. Shading by thinly spaced black locust or walnut trees may be beneficial. In well-established and carefully managed pastures, no serious problems of erosion control are present; but some special practices may be required in order to obtain good stands. In all places gullies should be controlled by check dams, and in some places terraces may be needed to stabilize the soil and establish favorable moisture conditions. Contour furrowing and seeding offers an excellent means of conserving soil moisture for pasture plants and preventing erosion.

Fullerton silt loam, steep phase.—Mapped on steep slopes, 25 percent or more, this phase is underlain by cherty dolomites of the Copper Ridge or Beekmantown formations. The greater part of the total area of 1,124 acres has slopes of 25 to 35 percent. Internal drainage is moderate and surface drainage, very rapid. The soil is chiefly in the cherty-ridge section southwest of New Tazewell, and most of it is in comparatively small-sized areas in association with other Fullerton soils and with Clarksville, Claiborne, and Bolton soils on hilly and steep slopes. Native vegetation was a deciduous forest of oak, hickory, blackgum, sweetgum, dogwood, and possibly shortleaf pine.

The profile is similar to that of the normal phase, but the various layers may be somewhat thinner, and, where cleared, more of the original surface soil has been lost by accelerated erosion. The upper 4 to 6 inches is friable gray silt loam with a fine granular structure. Where severely eroded, this layer may be missing and the original subsoil is at the surface; in such places favorable tilth is maintained with difficulty. Reaction is strongly acid. The organic-matter content is very low because of depletion of the original small supply through cropping and erosion losses. The soil is permeable to moisture, plant roots, and air; but moisture conditions for plant growth are only fair because of the large loss of water in surface runoff. Some angular chert fragments are on the surface and in the soil.

The subsoil is similar to that of the normal phase—it is yellowish-red or light-red cherty silty clay loam with a well-developed nut structure. It is about 2 feet thick and grades into red cherty silty clay with a coarse nut structure. Cherty-dolomite bedrock is at depths of 20 feet or more.

The principal variations included are due to differences in the degree of accelerated erosion. All the original surface layer of the soil in forest is present, being about 10 inches thick. In a few cleared places

this original surface soil is entirely missing, and the original subsoil is at the surface. In some places the boundary between this soil and some associated soil is not sharp, and small areas of other steep phases of Fullerton, Clarksville, and Claiborne soils may be included.

Use and management.—Present use and management of Fullerton silt loam, steep phase, are not well adjusted to the properties of the soil. About 25 percent of the phase is in forest, 10 percent in corn, 20 percent in hay, 25 percent in pasture, and 20 percent in idle land or wasteland. Crops are not rotated, and corn is grown for several years until yields are very low. The land may then be abandoned for several years. Lespedeza is the chief hay crop, and the poor quality pastures are often chiefly broomsedge. Small quantities of fertilizer are used on corn, but none is ordinarily used on hay or pasture. Little of the soil ever receives lime. From necessity, tillage is on the contour, but no special practices for controlling runoff and preventing erosion are used. Under common management, yields of about 10 bushels of corn and less than $\frac{3}{4}$ ton of hay to the acre may be expected.

This phase is so difficult to conserve and work that it is poorly suited to use for cropland; but where properly managed, it may produce fairly good pasture. Bluegrass and white clover, redbud, orchard grass, Bermuda grass, and lespedeza may be used in pasture mixtures. Fairly heavy applications of phosphorus and potash are needed by legumes or legume-grass mixtures. Grasses require nitrogen in addition, and lime at periodic intervals is necessary to establish and maintain all pasture stands. Grazing should be controlled during extremely wet or dry periods. Weeds can be controlled largely by proper use of soil amendments and by careful grazing, but clipping may sometimes be necessary. Gullies should be stabilized by check dams and tree plantings, but other means for control of runoff and erosion are not ordinarily needed because the roots of pasture plants effectively bind the soil mass and greatly increase its water-absorbing properties so that surface runoff is lessened and erosion prevented. Thinly spaced plantings of black locust and walnut trees may be beneficial on bluegrass pastures.

GREENDALE SERIES

Soils of the Greendale series are on well-drained foot slopes and benches along small intermittent streams and in the bottoms of lime sinks in cherty ridges (pl. 8). They differ from the Emory soil in being more acid, less fertile, dominantly gray rather than brown in the surface soil, and dominantly yellow rather than brown in the subsoil. Clarksville and Fullerton soils are on the adjoining uplands, and Roane soil is on the nearby bottom lands. About two-fifths of the area is nearly level and the rest is sloping. None of the soil is severely eroded, and although all of it is moderately cherty, none is sufficiently so to prevent tillage.

The surface soil is gray or light grayish-brown moderately cherty silt loam. It is underlain by a yellow or light brownish-yellow moderately cherty silt loam or silty clay loam subsoil. The parent materials are grayish or brownish colluvial and local alluvial materials that were rolled or washed from the Clarksville and Fullerton soils on the adjoining uplands. Dolomite bedrock is at a depth of many feet.

Although the Greendale soils are only moderately productive, they are more productive than the soils on the immediately adjacent uplands. They are suited to rather intensive use because of their favorable physical properties, and under good management moderate crop yields of excellent quality can be obtained. Management requirements are concerned chiefly with proper choice and rotation of crops and use of needed fertilizers and soil amendments. The silt loam and its sloping phase are mapped.

Greendale silt loam.—Occurs on well-drained nearly level foot slopes and benches along small intermittent streams and in the bottoms of lime sinks in cherty ridges. Along the streams it is in long narrow strips, but in lime sinks it is in small irregularly shaped areas. The parent materials are colluvial and local alluvial materials rolled and washed from uplands underlain by cherty dolomite. The soil was developed under a hardwood forest similar to that on the adjoining upland soils, but because of the higher inherent fertility and more favorable moisture conditions trees were probably larger on this soil. Slopes are 1 to 7 percent, and both internal and surface drainage are moderate. The aggregate area of 1,216 acres is in all the cherty ridge sections. Soils of the Clarksville and Fullerton series are on the adjoining uplands; Greendale silt loam, sloping phase, and Emory silt loam are associated with it in the colluvial lands; and the Roane and Lindsides soils are in the nearby bottom lands along some of the larger streams.

This young soil does not have a well-developed profile. To a depth of 8 to 10 inches the surface soil is gray or light grayish-brown friable silt loam. Although it is relatively low in organic matter and low to medium in phosphorus and potash content this soil is higher in these constituents than are the soils of the adjoining uplands. Reaction is medium acid. Moisture conditions are favorable for plant growth because of the favorable moisture absorbing and retaining properties and the gradual movement of moisture from the surrounding uplands to these lower soils. Tillage operations can be carried on over a moderately wide range of moisture conditions and good tilth is maintained with ease. Where lime and organic matter have been depleted by poor management, however, the soil puddles if plowed when too wet. A small or moderate quantity of angular chert fragments is on the surface and in the soil.

The light brownish-yellow or yellow subsoil is silt loam or light silty clay loam. It has a weakly developed subangular nut structure and contains some angular chert fragments and small black concretions. This layer is 18 to 24 inches thick, and in some places the lower 4 to 6 inches is somewhat cemented or compacted. The underlying parent material is grayish or brownish colluvial or local alluvial material that has washed or rolled from the Clarksville and Fullerton soils on the adjoining upland slopes. Dolomite bedrock is at a depth of many feet.

Use and management.—Practically all of Greendale silt loam is now used for purposes for which it is fairly well suited physically, but increased yields can be obtained in most places by improved management practices. All the soil is cleared and cultivated—about 30 percent for corn; 25 percent for small grains, chiefly wheat; 15 percent for burley tobacco; and 30 percent for hay, with small acreages of fruits

and vegetables. Lespedeza, red clover, and timothy are the chief hay crops. A rotation of corn, wheat, and lespedeza or red clover is used by some farmers; but usually systematic rotations are not used, and corn or tobacco is grown for several successive years followed by hay or wheat.

Less than half the soil is limed at periodic intervals. Tobacco is usually fertilized heavily with a complete fertilizer. Where available, barnyard manure supplemented with superphosphate is applied. Wheat and corn receive a small quantity of 0-10-4 fertilizer or 16- or 20-percent superphosphate. Hay crops are not ordinarily fertilized, but they receive some residual benefits from fertilizers applied to other crops. Most tillage operations are done promptly; in fact, many farmers use a large proportion of their time, labor, and capital on this soil because it is more productive and more responsive to management than the soils of the adjoining uplands. Under common practices of management, average yields of about 28 bushels of corn, 13 bushels of wheat, 1,000 pounds of burley tobacco, 1 ton of lespedeza, and 1¼ tons of red clover may be expected to the acre.

Requirements for good management are simple and can be easily accomplished. They are concerned chiefly with proper choice and rotation of crops and the correct use of fertilizers and soil amendments. The soil is suited to a wide variety of crops, including corn, burley tobacco, wheat, barley, oats, red clover, crimson clover, soybeans, timothy, potatoes, vegetables, and small fruits. It is suited to intensive use; and under careful management, a row crop can be grown every other year. A row crop followed by small grain seeded to crimson clover to be turned under the following spring as a green manure is a useful rotation. Where a longer rotation can be used, corn, small grain, and red clover are well suited.

Legumes are effective in increasing humus and nitrogen and improving tilth, but lime is necessary to insure success with legumes. In addition to neutralizing soil acidity lime furnishes calcium to the plants. Legumes require moderate to heavy applications of phosphorus and potash. Tobacco requires medium to large quantities of complete fertilizers containing much phosphorus and potash and medium or small quantities of nitrogen. Corn and small grains need similar fertilizers but in smaller quantities and with lower proportions of potash. The fertilizer requirements of potatoes and other vegetables are similar to those of tobacco. Barnyard manure is an excellent source of potash and nitrogen and also serves to increase humus, but it should be supplemented with phosphorus fertilizers to obtain the proper balance of plant nutrients.

In general, the soil requires no special practices for preventing erosion and conserving moisture, but in some places it may be necessary to build check dams in the small intermittent streams along which the soil is found in order to prevent bank cutting. In all places, runoff from the adjoining uplands should be controlled to prevent erosion and protect this soil from overwash of heavy subsoil materials.

Greendale silt loam, sloping phase.—Areas of this soil occupy a total of 2,212 acres on sloping benches and foot slopes along intermittent streams and in the bottoms of large lime sinks in the cherty ridges. The soil was developed under a hardwood forest, and its parent materials are derived from local alluvium and colluvium.

Slopes range from 7 to 20 percent, with the greater part having slopes of less than 12 percent. Both internal and surface drainage are moderate. The soil is in small narrow strips or small irregularly shaped areas in all the cherty ridge sections of the county, but the largest proportionate acreage is in the ridges in the central part. Clarksville and Fullerton soils are on the adjacent uplands, and the normal phase, Emory silt loam, and the Roane soil are in the colluvial lands and nearby bottom lands.

This young soil is similar to the normal phase, but the various layers may be thinner. Part of the soil is slightly or moderately eroded. The surface 6 to 8 inches is a gray to light grayish-brown friable silt loam that is low in organic matter and medium in acidity. Soil moisture conditions are fairly good, but they are less favorable than in the normal phase because of the stronger slopes and the consequent greater loss of water through surface runoff. Good tilth is fairly easily maintained. A small or moderate quantity of chert is on the surface and in the soil. In places on the stronger slopes where the soil has been intensively used, a large part of the surface layer may be missing; whereas in other places it may be buried under chert and heavy subsoil materials that have eroded from the adjoining upland soils. In all these places good tilth is more difficult to maintain, moisture conditions are poorer, and the soil is less productive.

The light brownish-yellow or yellow subsoil is silt loam or light silty clay loam with a weakly developed nut structure. It is slightly to moderately cherty and contains some small dark-colored concretions. This layer is 15 to 24 inches thick and is underlain by colluvium or local alluvium washed or rolled from the adjoining uplands from Clarksville or Fullerton soils. Dolomite bedrock is at a depth of many feet.

Use and management.—The present use of practically all Greendale silt loam, sloping phase, is fairly well adjusted to its physical properties; but management is not so well adjusted as on the normal phase, largely because this phase is more exacting in its requirements. Essentially the same management practices are used on both soils. At present all the soil is cleared and cultivated; about 40 percent is used for corn, 15 percent for small grains, 15 percent for tobacco, and 30 percent for small acreages of vegetables and for hay—largely lespedeza, timothy, and red clover. General management practices are practically identical to those used on the normal phase, but yields are slightly less. Estimated average acre yields obtained under common management are 25 bushels of corn, 10 bushels of wheat, 900 pounds of burley tobacco, 1 ton of lespedeza, and 1¼ tons of timothy and clover.

Requirements for good management are comparatively simple, but they are more exacting than those on the normal phase because of the stronger slopes. These requirements are concerned with proper choice and rotation of crops, selection and use of soil amendments, and some simple practices for controlling runoff and preventing erosion. The soil is suited to the same wide variety of crops as the normal phase, and similar rotations are well suited, but more care should be taken to have winter cover crops each season. Row crops should be grown less frequently. The requirements of fertilizers and soil amendments are practically the same as for the normal phase. Contour tillage should be practiced to prevent erosion, and runoff from adjoining uplands

should be diverted from this soil to prevent erosion and to avoid covering the surface soil with large quantities of chert and heavy subsoil material from severely eroded upland soils.

GUTHRIE SERIES

The Guthrie series is in the nearly level bottoms of poorly drained sinks in the limestone valleys. Dewey and Talbott soils are on the adjoining uplands. This is a poorly drained soil. The largest proportionate acreage is in Powell Valley. This is a young soil without a definite profile. In general the surface soil is mottled gray or yellowish-gray silt loam; the subsoil is heavier in texture and more heavily mottled; and a heavy dark-gray silty clay substratum rests on limestone residuum or bedrock at a depth of several feet. Only one type, the silt loam, is mapped.

Guthrie silt loam.—Small areas of this soil—many less than an acre in size—occur in the nearly level bottoms of small shallow sinks in limestone valleys. The parent materials of colluvium and local alluvium have washed and rolled from adjoining uplands underlain chiefly by moderately high-grade limestone or by cherty dolomite. Practically all the soil (68 acres) is in Powell Valley. The Dewey and Talbott soils are associated on the adjoining uplands, the Fullerton and Clarksville on the nearby ridges, and the Ooltewah in the depressions. Slopes are less than 2 percent, and both internal and surface drainage are slow. Native vegetation was a mixed forest of willow oak, water oak, red maple, blackgum, sweetgum, and willow.

This young soil does not have a well-developed profile. The 4- to 6-inch surface layer is gray or yellowish-gray silt loam faintly mottled with red and brown. This material is rather loose and floury in consistence when dry but moderately sticky when wet. Organic-matter content is low, and reaction is medium to strongly acid. Moisture conditions for most crops are poor, inasmuch as the surface soil is saturated with water much of the year and water stands at least a few days after each rain. Tillage therefore is generally impractical. In most places the soil is free of stone or chert; in a few places, however, where Fullerton or Clarksville soils are on the adjoining uplands, it may be somewhat cherty.

The upper subsoil is yellowish-gray light silty clay loam profusely mottled with red and brown and containing reddish-brown soft concretions. This layer is 8 to 15 inches thick and grades into heavy dark-gray silty clay containing some yellowish-brown soft concretions. Limestone residuum or bedrock is at depths of several feet.

As mapped, variations are in the color and texture of the surface soil and subsoil, in the thickness of the various layers, and in the origin of parent material. None of these variations, however, is of sufficient importance to alter materially the use suitability and management requirements of the soil.

Use and management.—The present use and management of Guthrie silt loam are variable, but in general they are not well adjusted to the physical properties of the soil. All the soil is cleared, and unsuccessful attempts are made to use part of it for crops, chiefly corn. Part of the soil is in pasture consisting chiefly of native wild grasses and occasionally some bluegrass and white clover. Fertilizer and lime

are not ordinarily used on either crops or pastures, and yields are very low.

Because of poor drainage this soil is not suited to crops, but under careful management fair to good pastures may be obtained. Management requirements are concerned chiefly with supplying soil amendments to properly chosen pasture-plants. On the best drained parts, bluegrass, white clover, and possibly alsike clover will do fairly well; on the less well-drained areas redbud and lespedeza will grow; and on the poorest drained parts native grasses and sedges are the only plants that can survive.

Moderate quantities of phosphorus and lime are required to obtain good growth of legumes. Other amendments are probably not required. Where adequate amendments are used weed growth will be greatly reduced; but where it is feasible, pastures should be mowed a few times each year to eliminate weeds. The soil should not be grazed during wet periods, inasmuch as the grazing animals will puddle the surface soil and the already poor drainage conditions will be further impaired. Ordinarily, artificial drainage cannot be accomplished because of the position of the soil in the depressions, but in some places it may be possible to remove or divert some of the surplus surface water by the use of shallow open ditches. It may not be feasible to use any special management practices on the most poorly drained parts—some of these areas will furnish poor quality pasture of native plants; whereas others are suited only to forest.

HARTSELLS SERIES

The Hartsells soil is a relatively shallow sandy soil on the broader rolling mountaintops in the Cumberland Mountain section. It is associated with Muskingum soils, but differs from them in having a somewhat more distinctly developed profile, milder slope, and less stone. This soil is of small agricultural value because of its relatively small acreage and its association with nonagricultural soils.

Where cleared, the surface layer is yellowish-gray friable fine sandy loam 4 to 6 inches thick. The yellow fine sandy clay loam subsoil is underlain by mottled yellow fine sandy clay. Consolidated sandstone or conglomerate bedrock is at a depth of about 3 feet below the surface in most places. Most of the soil has stone fragments on the surface and in the soil layers sufficient to interfere with tillage. The stony fine sandy loam is the only type mapped in the county.

Hartsells stony fine sandy loam.—Differs from Muskingum soils chiefly in having milder slopes and a less stony, more distinctly developed profile. The total area of 548 acres is on the rolling crests and benches of lower Cumberland Mountain underlain by massive sandstone and conglomerate. Slopes are 3 to 10 percent, and internal and surface drainage are moderate. Areas are on the north side of Valley Creek, south of Marion, and between Little Tackett and Tackett Creeks. Muskingum stony fine sandy loam is on the adjoining mountain slopes, and small areas of Atkins soil are along the small streams that rise on the flat areas. Other small areas are on the crests of Brushy Ridge and west of Skaggs Ridge in the valley section. Native vegetation was a mixed forest of post, white, blackjack, red, and chestnut oaks, some hickory, and blackgum.

Where cleared, the surface 4 to 6 inches is yellowish-gray friable fine sandy loam. It is very strongly acid, very low in inherent fertility, and low in organic matter. Moisture conditions for plant growth are only fair because of the open porous properties of the soil and its low moisture-holding capacity. Good tilth is maintained with ease, but enough sandstone fragments are on the surface and in the soil to interfere materially with tillage.

The 24-inch subsoil is yellow stony fine sandy clay loam. It is underlain by yellow fine sandy clay mottled with red, brown, and ocher in the lower part and is somewhat firm and brittle. Massive sandstone or conglomerate bedrock is at depths of 36 to 48 inches.

The chief variation mapped is due to the differences in the degree of accelerated erosion. In a few places nearly all the original surface layer is missing, and the upper subsoil is now at the surface. The quantity of sandstone fragments on the surface and in the soil also varies. On the crest of Brushy Ridge the subsoil has a heavier texture than is normal. One or two small areas have a stony grayish-brown surface soil and a red subsoil. None of these variations is essentially different in use and management requirements.

Use and management.—Present use and management of Hartsells stony fine sandy loam are not well adjusted to the physical properties of the soil. Practically all of it is cleared and used for corn, hay, potatoes, vegetables, and fruits on part-time or subsistence farms. Crops are not rotated; corn is grown for a few years followed by several years of hay or pasture. Some lespedeza is grown, but most pasture and hay fields contain timothy mixed with native wild grasses. Very little of the soil is ever limed, and commercial fertilizer is not ordinarily used on any of the crops. Barnyard manure is used where it is available, but the quantity is small because of the small numbers of livestock on the farms. No special practices for preventing erosion and conserving moisture are used. Under prevailing management, acre yields of about 15 bushels of corn and $\frac{3}{4}$ ton of lespedeza or mixed hay may be expected.

The use suitability is determined largely by the size of the areas—where areas are large enough for a farm unit, the soil is used for cropland; but small isolated areas cannot be used economically for cropland because they are associated with nonagricultural soils. Where the soil is suited to growing crops, management requirements center about increasing the supplies of humus and nitrogen and supplying fertilizers and soil amendments. A 4-year rotation of a row crop followed by a small grain seeded to a legume is well suited. Corn, small grains, crimson clover, lespedeza, red clover, timothy, potatoes, vegetables, and fruits are suited if the soil is properly managed. Lime is needed for legumes, which should have an important place in the rotation. All crops require phosphorus and potash, and most crops other than legumes should receive nitrogen in fertilizers. The soil can be worked over a wide range of moisture conditions without injury to tilth. Contour tillage and strip cropping are effective in conserving moisture and preventing erosion but terraces are of questionable value.

HAYTER SERIES

In some places where two or more individual classification units are associated in such a close and intricate pattern that they cannot be delineated separately on the soil map, they are mapped as complexes. A complex pattern of Talbott and Hayter soils is on the hilly and steep slopes of valley mountains. These soils are underlain by high-grade limestone, but in places colluvial material from the higher mountain slopes is part of the parent material.

The soils of the Hayter series are on low, nearly level to gently sloping benches, and on fans in limestone valleys at the foot of valley mountain slopes. Many areas, however, may be on hilly and steep slopes on the lower mountain spurs. In the valleys the soil is associated with Talbott and Dewey soils and the miscellaneous land types of Talbott soil material; whereas on the mountain slopes it is associated with Talbott, Armuchee, and in places Lehew soils. These soils differ from the Caylor soils chiefly in having a younger profile and in being deeper over limestone bedrock or residuum.

To a depth of 12 to 18 inches the surface layer is dark-brown friable loam to silt loam underlain by a dominantly strong yellowish-brown silty clay loam subsoil 2 to 3 feet thick. The yellowish-brown substratum ranges from heavy silt loam to silty clay loam and consists of local alluvium and colluvium washed from a mixture of sandstone, shale, and limestone materials. This layer is underlain at a considerable depth by limestone residuum or limestone bedrock. This soil is slightly to medium acid and moderate to high in natural fertility.

Although the Hayter soil is not mapped individually, significant acreages are included in the Talbott-Hayter complex mapped on the lower slopes of the mountains bordering the limestone valleys. Because of the steep slopes the complex is poorly suited to tilled crops, but moderate natural fertility and relatively favorable moisture conditions make the complex well suited to pasture. Management requirements are concerned chiefly with pasture management. Two complexes—Talbott-Hayter silt loams and Talbott-Hayter silt loams, steep phases—are mapped. The Talbott series is described on page 150.

Talbott-Hayter silt loams.—An aggregate area of 706 acres is mapped on the hilly lower slopes of valley mountain ridges in small or medium-sized areas very closely associated with the hilly and steep phases of Talbott silt loam and with Talbott-Hayter silt loams, steep phases. It is underlain chiefly by high-grade limestone of the Trenton formation, from which part of the soil is derived. The rest of the parent material is from colluvium, washed and rolled from the upper mountain slopes, underlain by shale of the Reedsville and Juniata formations and sandstone of the Clinch formation. Native vegetation was chiefly a hardwood forest of oak, hickory, maple, beech, walnut, and dogwood. Slopes range from 15 to 30 percent, but are usually fairly high. Internal drainage is moderate, and surface drainage is rapid. This complex is on the lower northwest-facing slopes of Powell Mountain and Wallen Ridge.

Talbott silt loam, hilly phase, is on half or more of any given area of this complex; the rest of the land is covered with a soil derived from colluvium of sandy and shaly materials from the upper mountain slopes. The colluvial soil is typically brown silt loam or fine

sandy loam 6 to 12 inches thick, which is underlain by a yellowish-brown or brownish-yellow silt loam or light silty clay loam. Heavy reddish or yellowish limestone residuum is at depths of 20 to 30 inches. The complex as a whole is strongly acid and relatively low in organic matter. Soil moisture conditions are generally good; but the ease with which good tilth is maintained varies from place to place depending upon the thickness and texture of the surface soil. Tillage is moderately difficult because of the strong slopes. A considerable quantity of angular reddish sandstone fragments is on the surface in many places.

As this mapping separation is a complex, it is characterized by many variations. These are due chiefly to differences in the proportion of the Talbott and Hayter soils, in the depth of the colluvial deposition over limestone residuum, and in the number and size of sandstone fragments on the surface.

Use and management.—The present use and management of Talbott-Hayter silt loams vary somewhat from place to place and are only fairly well adjusted to the physical properties of the complex. Practically all the soil is cleared and used for pasture and small acreages of corn. The present pasture is chiefly mixed tame and wild grasses, with either broomsedge or bluegrass being the dominant plant. A few farmers apply phosphorus and lime; but generally no special management practices are used, and the pasture is of fair quality with low yields. Where corn is grown, management is generally at a low level and yields are small.

The use suitability is limited, but management requirements are comparatively simple when the soil is properly used. Under present conditions pasture is probably the best use, and management requirements are concerned chiefly with selecting pasture plants, using lime and fertilizer, and controlling grazing. In general the requirements for this complex are similar to those of Talbott silt loam, hilly phase.

Talbott-Hayter silt loams, steep phases. Associated chiefly with its normal phase and with the hilly and steep phases of Talbott silt loam, this complex occupies 439 acres on valley mountains. It is underlain by high-grade limestone on the lower steep slopes adjacent to the small intermittent streams that dissect the mountain slopes. Native vegetation was a hardwood forest of oak, hickory, maple, black walnut, and dogwood. Slopes range from 30 to 60 percent, but are predominantly in the lower part of the range. Surface drainage is very rapid, and internal drainage is moderate. Small- or medium-sized areas are on the northeast-facing slopes of Powell and Lone Mountains and Wallen Ridge.

Differences between this complex and the normal complex are chiefly caused by the steeper slopes. This one is somewhat more eroded; the proportion of the total area covered by colluvial materials is smaller; and the average thickness of the colluvial deposition is somewhat less. As a result, conditions are less favorable for plant growth; good tilth is more difficult to maintain; and tillage is more difficult.

Use and management.—The present use of Talbott-Hayter silt loams, steep phases, is fairly well adjusted to its physical use suitability; but management practices are not designed to conserve or improve the complex. Practically all the soil is cleared and used almost entirely

for pasture consisting chiefly of broomsedge mixed with other wild and tame grasses. In some places bluegrass alone or mixed with white clover is the dominant pasture plant. Some farmers use lime and superphosphate, but in many places no amendments are applied. No special measures for eradicating weeds are used, and special methods for controlling runoff are not practiced. Fair grazing is furnished by the present pasture in spring and fall, but the pasture is usually of poor quality in summer.

Because of its steep slopes this complex is poorly suited to cropland, but under good management high quality pasture can be obtained. Management requirements center about furnishing lime and fertilizer to properly chosen pasture mixtures, preventing excessive runoff, and controlling weeds and grazing. Management requirements are similar to those of Talbott silt loam, steep phase

HOLSTON SERIES

The soil of the Holston series is on the older, higher stream terraces underlain by alluvium washed chiefly from acid shale and sandstone. This soil is not so well drained as the Waynesboro soil but better than the Monongahela soil. Relief is nearly level to sloping. Areas are on the terraces along the Powell River and some of its tributaries that flow through Powell Valley. Most of it is on gentle slopes and none is seriously eroded.

To a depth of 8 to 10 inches the surface layer is gray to grayish-yellow loose open fine sandy loam. The subsoil is yellow loam or silt loam to brownish-yellow fine sandy clay or clay loam. This layer is underlain by several feet of mottled yellow, brown, or red sandy clay containing beds of water-worn gravel, which in turn is underlain by limestone residuum or bedrock. Only one type, the fine sandy loam, is mapped.

Holston fine sandy loam.—This soil is on the older, higher stream terraces underlain by old alluvium washed mainly from acid shale and sandstone of the uplands. Native vegetation was a hardwood forest of oak, hickory, and associated trees. Slopes are usually less than 7 percent but may be as steep as 15 percent. Surface drainage is moderate to slow depending upon the slope, but internal drainage is rather slow everywhere. Part of the 277 acres mapped is in small areas on the older, higher terraces along the Powell River in association with the Sequatchie soils on the adjoining lower terraces and with various soils from dolomitic materials on nearby uplands. Areas also are on the terraces of small streams in Powell Valley associated in a complex pattern with various soils of the terrace lands, colluvial lands, and bottom lands. A small quantity is in the valley of Big Sycamore Creek associated chiefly with the Monongahela, Philo, and Leadvale soils.

This profile is well developed. The surface 8 to 10 inches is gray to grayish-yellow rather loose open fine sandy loam. It is strongly acid and very low in organic matter. Good tilth is easily maintained because of the light texture and friable consistence. Moisture conditions are generally favorable for plant growth; although during periods of dry weather, crops may be injured by lack of moisture. The soil is ordinarily stone-free; but locally, chert fragments from the adjoining upland slopes have rolled down onto the surface.

The upper 4 to 6 inches of the subsoil is yellow or grayish-yellow rather brittle loam or silt loam. It breaks sharply to yellow or brownish-yellow fine sandy clay or clay loam, which in the lower part is rather firm in place and contains some mottlings and soft-brown concretions. These layers range in thickness from 10 to 20 inches and are underlain by several feet of yellow, brown, or red fine sandy clay containing mottlings of brown, yellow, and gray. Lenses or thin layers of sand, fine sandstone, and quartz gravel are present. Limestone residuum or bedrock underlies this layer.

Other than small local differences in stoniness, slope, and erosion, no significant variations are included.

Use and management.—The present use of Holston fine sandy loam is fairly well adjusted to its physical properties, but management practices for improving or conserving the soil are not used. Practically all the soil is cleared and used chiefly for corn, hay, and tobacco; but a small part is idle or fallow each year. Crops are not rotated. Tobacco receives small or moderate applications of fertilizer, and corn light applications; but hay generally is not fertilized. Practically none of the soil is ever limed. No practices for improving soil moisture conditions are commonly used. Under prevailing management practices acre yields of 20 bushels of corn, 600 pounds of burley tobacco, and $\frac{3}{4}$ ton of lespedeza or mixed hay may be expected.

Requirements for good management vary somewhat from place to place depending on local differences in slope and erosion. In general, the requirements are concerned with the correct choice and rotation of crops, use of lime and fertilizers; and, on the stronger slopes, the prevention of erosion and conservation of soil moisture. The soil can be conserved under a rotation including a row crop once in 3 or 4 years. Crops suited to the soil are corn, small grains, hay—with the possible exception of alfalfa—vegetables, and fruits. Burley tobacco is fairly well suited, but yields and quality are somewhat lower than on better drained soils on comparable slopes. Although the soil is derived from different materials, requirements for fertilizers and other amendments and practices for controlling runoff are similar to those for Fullerton loam.

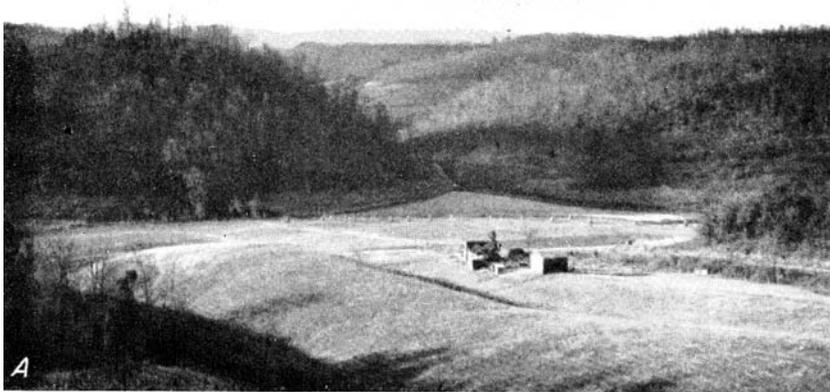
JEFFERSON SERIES

The Jefferson soils are on well-drained foot slopes and benches at the base of mountains (pl. 9). They differ from the Caylor and Allen soils (1) in being immediately adjacent to the mountain slopes, whereas those soils are farther in the valley, and (2) in having parent material derived almost entirely from sandstone material instead of containing some shale and limestone. These soils are along the foot of the Cumberland escarpment in Powell Valley and in the valley of Big Sycamore Creek and along the creek valleys on Cumberland Mountain. About one-fourth of them have nearly level to gently sloping relief, and the rest are sloping. All areas are sufficiently stony to interfere materially with tillage, but none is severely eroded.

Although the profile is weakly developed, the gray or yellowish-gray stony fine sandy loam surface layer is underlain by a brownish-yellow silty clay loam or sandy clay loam subsoil. The substratum is colluvial material consisting of a mixture of fine sandy clay and



Landscape in the Monongahela-Leadvale-Jefferson association. Tobacco in foreground is on Monongahela soil, corn in center on Philo soils; buildings and pasture on Jefferson soil; the wooded slope of Powell Mountain in background on Muskingum soils.



- A*, Landscape in the Montevallo-stony land-Leadvale association. Montevallo soils extend from immediate foreground to buildings; Leadvale soils are on the benchlike area beyond the buildings; Philo soils in the narrow creek bottom land; and Montevallo soils on steep slopes above the bottom land.
- B*, Landscape in the Monongahela-Leadvale-Jefferson association with Muskingum soils on the mountain in background. Practically all the valley is cleared land, with corn and hay the important crops.

sandstone fragments. Depth of this material varies and the underlying rock may be sandstone, shale, or limestone.

Although these soils are stony, acid, and infertile, they are responsive to good management and are fairly well suited to cropland. Their management requirements are concerned chiefly with the use of soil amendments and the proper choice and rotation of crops. The stony fine sandy loam and its sloping phase are mapped.

Jefferson stony fine sandy loam.—A total area of 627 acres of this soil is mapped on the well-drained fans and benches at the base of mountain slopes. Relief is 2 to 7 percent. The parent materials of colluvium or local alluvium have rolled or washed from Muskingum soils on the adjoining uplands. Native vegetation was a mixed forest of oak, hickory, sourwood, sweetgum, dogwood, and shortleaf pine. In the mountain section, hemlock, beech, maple, holly, and mountain-laurel are commonly found.

Most of the soil is in small areas at the foot of the Cumberland escarpment in Powell Valley associated chiefly with the sloping phase and with Allen soil in the colluvial lands, with Talbott and Dewey soils on the adjoining valley uplands, and with Muskingum soils on the adjacent mountain slopes. A small area is in the creek valleys on Cumberland Mountain in relatively long narrow strips along the base of the mountain slopes. Muskingum soils are on the adjoining mountains and Pope and Philo soils on the creek bottom lands. It also is in the valley of Big Sycamore Creek at the base of Brushy Ridge, on Powell Mountain, and on Skaggs Ridge—all of which have Muskingum soils on their slopes. The sloping phase and the Leadvale soils are associated with it on the colluvial lands, and Monongahela, Tyler, Pope, and Philo soils are on the stream terraces and bottom lands.

The rather weakly developed profile varies somewhat from place to place. The 6- to 8-inch surface layer is gray or yellowish-gray rather loose stony fine sandy loam. It is strongly acid in reaction and low in organic matter. The moisture absorbing and retaining properties are relatively poor because of the light texture, stoniness, and low humus content of the soil. As a result, plants are injured by lack of moisture even during short droughty periods. Sufficient sandstone fragments are on the surface and in the soil to interfere with tillage, and good tilth is difficult to maintain.

The brownish-yellow subsoil is friable light silty clay loam or sandy clay loam. It is somewhat friable when dry and slightly sticky when wet. At a depth of about 2 feet this layer grades into a dominantly yellow sandy clay mottled with gray, brown, red, and yellow. This colluvial deposit is several feet thick in most places and may be underlain by sandstone, shale, or limestone.

A few variations are included. The depth of deposition of colluvial material ranges from as little as 3 feet to more than 15. On Cumberland Mountain the parent material is derived entirely from sandstone material; whereas in the valley sections some shale and limestone may be included. A few areas of the soil are so stony that they cannot be cultivated.

Use and management.—The present use of Jefferson stony fine sandy loam is fairly well adjusted to its physical properties, but management practices designed to improve the soil or to compensate for

its deficiencies are not commonly used. Practically all the soil is cleared, with corn, lespedeza, tobacco, and vegetables being the chief crops. A small acreage is used for pasture and some is idle. Crops are not ordinarily rotated. Row crops are grown for a few successive years, and the soil is then seeded to lespedeza for hay or pasture; but in some places it remains idle after the row crop and grows up to broomsedge and brush. Tobacco receives moderate to large applications of complete fertilizer, but other crops are fertilized very lightly or not at all. Very little of the soil is limed at regular intervals, and no special attempt is made to conserve soil moisture. Acre yields of about 15 bushels of corn, 450 pounds of burley tobacco, and $\frac{1}{2}$ ton of lespedeza or mixed hay may be expected under the prevailing systems of management.

Because of stoniness, low fertility, strong acidity, and poor tilth and moisture conditions, good management requirements are rather exacting. Good management should improve or compensate for the various unfavorable features of the soil. If other requirements are met, the soil can be conserved under a rotation including a row crop once in 3 years. Vegetables, burley tobacco, corn, small grains, timothy, and clover are among the crops suited to the soil. Legumes are important in rotations, for they increase the humus and nitrogen contents and improve tilth and moisture conditions.

All crops require fertilizer, but applications should be made in relatively moderate quantities at frequent intervals in order to meet the immediate needs of each crop. Corn, small grains, and tobacco should receive complete fertilizers containing nitrogen, phosphorus, and potash, the proportion of potash being made relatively high for tobacco. The requirements of potatoes and other vegetables are similar to those of tobacco. Legumes need phosphorus, potash, and lime but no nitrogen. Tilth is greatly improved when legumes that have received proper amendments are included in the rotation, but it can be further improved in most places by the removal of stones. Tillage should be on the contour, especially on the steeper slopes; but where the soil is carefully managed in other respects, other special measures for preventing erosion and conserving soil moisture are generally unnecessary.

Jefferson stony fine sandy loam, sloping phase.—Slopes of this phase are 8 to 15 percent, and internal and surface drainage are somewhat rapid. Areas occur on the sloping fans and benches in relatively long narrow strips at the base of mountains. The parent materials of colluvium and local alluvium have rolled and washed from the Muskingum soils on the mountain slopes. Native vegetation was a mixed forest of oak, hickory, sweetgum, and shortleaf pine, with some hemlock, maple, beech, holly, and mountain-laurel in the sites with more favorable moisture conditions.

The soil is on Cumberland Mountain in association with Muskingum soils on the adjacent mountain slopes and with Pope and Philo soils in the nearby creek bottom lands. It is in Powell Valley associated with the normal phase and the Allen soil on the colluvial lands and with Talbott and Dewey soils on the nearby uplands. It also is in Skaggs and Brushy Ridges and in the valley of Big Sycamore Creek at the foot of Powell Mountain associated with the normal phase and

Leadvale soils on the colluvial lands; with Monongahela, Tyler, Pope, and Philo soils on the terraces and bottom lands; and with Lebew and Muskingum soils on the nearby mountain slopes. The aggregate area mapped is 1,653 acres.

The profile is similar to that of the normal phase; but where the soil is cleared, more of the original surface layer is missing. The surface 4 to 6 inches is rather loose stony gray or yellowish-gray fine sandy loam. It is strongly acid in reaction and low in organic matter. Favorable moisture conditions are moderately difficult to maintain because of the stony, open, porous nature of the soil; and plants are injured by lack of moisture during periods of drought. Sandstone fragments on the surface and in the soil interfere with tillage. Where the soil is in forest, the surface layer is about 8 inches thick, and the upper inch or so is heavily matted with tree roots and stained with organic matter.

The brownish-yellow subsoil is moderately friable stony fine sandy clay loam to light silty clay loam. It is 18 to 24 inches thick and is underlain by sandy clay colluvial material containing sandstone fragments. Bedrock is at depths of several feet and may be either sandstone, shale, or limestone.

No significant variations are included other than those caused by differences in the degree of erosion and in the total depth of the colluvial deposits.

Use and management.—The present use of Jefferson stony fine sandy loam, sloping phase, varies from place to place; but where it is used for crops, management is at a low level. About a fourth of the soil is in forest, which is entirely on Cumberland Mountain. In the mountainous section the cleared area is used chiefly for potatoes, vegetables, and some corn; whereas in the valley section, burley tobacco, corn, and hay are the chief crops. Crops ordinarily do not receive any fertilizer or other amendments in the mountainous area; but in the valley section, tobacco is fertilized by most farmers, although corn and hay ordinarily are not. Special practices for preventing erosion and conserving soil moisture are not used. Under the prevailing system of management, acre yields of about 13 bushels of corn, 375 pounds of tobacco, and $\frac{1}{2}$ ton of lespedeza may be expected.

Requirements for good management are similar to those for the normal phase, but more care is needed to prevent erosion and conserve soil moisture. These requirements center about the proper selection and rotation of crops and the use of lime and fertilizers in order to (1) increase organic matter and nitrogen, (2) improve tilth and moisture conditions, and (3) prevent erosion. Rotations including a row crop once in 4 or 5 years are suited to the soil in its present condition, but as soil conditions improve row crops may be grown more frequently. This phase is suited to the same crops as the normal phase, and requirements for fertilizer and amendments are essentially the same. Contour tillage should be practiced on all the soil; and in some places broad-base terraces will be effective in preventing erosion and conserving soil moisture if they are carefully planned, constructed, and maintained.

LEADVALE SERIES

The Leadvale soils are on imperfectly drained fans and benches at the foot of shaly ridges (pl. 10, A). Their parent materials are derived from colluvial or local alluvial deposits that have washed or rolled from the Montevallo and Lehew soils on the adjacent ridges. About 40 percent of the soils have nearly level or gently sloping relief, and the rest have sloping relief. These soils differ from the Jefferson in that they are darker in color, heavier in texture, stone-free, more fertile, and have a hardpan. They are lighter in color, more acid, less fertile, and not so well drained as the Caylor soils.

The surface soil is light grayish-brown or grayish-yellow silt loam and the subsoil, yellow silty clay loam or silty clay. A mottled hardpan layer is at depths of about 2 feet. Acid shale or shale containing thin beds of limestone is at depths of several feet.

Although of relatively small acreage, these soils are very important from the standpoint of agriculture because they are generally the most productive soils of the shale valleys. All are moderately eroded, but they are at least fairly well suited to growing most common crops. Management requirements are concerned chiefly with proper choice and rotation of crops, use of lime and fertilizer, improvement of soil moisture conditions, and prevention of erosion on the stronger slopes. The silt loam and its sloping phase are mapped.

Leadvale silt loam.—An imperfectly drained soil on the fans and benches in valleys at the foot of slopes. The parent material is derived from colluvium or local alluvium that has rolled or washed from the nearby shale ridges. Native vegetation was a mixed forest of oak, hickory, sourwood, dogwood, and shortleaf pine. Slopes range from 2 to 7 percent with the greater part of the soil having mild slopes. Both surface and internal drainage are somewhat slow.

The total acreage mapped is 460 acres. Small-sized areas are in Caney Valley, with Montevallo and some Lehew soils on the adjacent uplands and Philo soils in the nearby bottom lands. Areas also are in the valley of Big Sycamore Creek associated with Jefferson soils on the colluvial lands; with Monongahela, Tyler, and Philo soils on the nearby terrace and bottom lands; and with Montevallo, Lehew, and Muskingum soils on the adjacent uplands. A small acreage is mapped in a complex pattern in Powell Valley in association with the Jefferson, Taft, Robertsville, Lindside, Melvin, Dewey, and Talbott series.

Although this is a relatively young soil, it has a distinct profile. The surface 10 to 15 inches is a light grayish-brown or grayish-yellow friable silt loam that is low in organic matter and strongly acid in reaction. Soil moisture conditions are favorable for most crop plants except deep-rooted legumes as alfalfa. In periods of heavy rains, the soil becomes saturated with water; but good tilth is fairly easily maintained except when the soil is plowed when too wet.

The 10- to 14-inch subsoil is moderately friable yellow silty clay loam with a weakly developed nut structure. Some small black concretions are in the lower part. It is underlain by yellow silty clay heavily mottled with gray and brown, which is compact in place and somewhat cemented. This layer is 3 or 4 feet thick and breaks into

large nutlike aggregates that are easily shattered. It is underlain by colluvium or local alluvium from acid shale or by shale bedrock.

Several variations are included. Areas at the foot of Brushy Ridge in the valley of Big Sycamore Creek have a fine sandy loam surface soil and a corresponding lighter subsoil. Some of the soil near the heads of small intermittent drains has a less distinctly developed profile than normal. Soil mapped in Powell Valley contains some limestone material and is underlain in most places by limestone, but in a few places sandstone fragments are on the surface. In places the soil is eroded to a considerable extent and acid shale bedrock is at shallow depths of 2 to 3 feet. None of these variations, however, is of sufficient extent to change materially the use suitability or management requirements of the soil.

Use and management.—Leadvale silt loam is used rather intensively, for it is one of the few soils in the shale valleys suited to crops. All of it is cleared and under cultivation. About half is used for corn, 15 percent for tobacco, and most of the rest for hay, with a small acreage in gardens. Systematic rotation of crops is not practiced, and row crops are grown by many farmers for as long a period as yields remain profitable. Very little of the soil is ever idle. Moderate to large applications of fertilizer are used on tobacco, corn is fertilized lightly or not at all, and hay receives no fertilizer. Only a small part of the soil is limed at regular intervals. Some attempt to improve drainage by open ditches is made by a few farmers. Under prevailing management practices, acre yields of about 25 bushels of corn, 750 pounds of burley tobacco, and three-fourths ton of lespedeza hay may be expected. Where lime is used in addition to other common practices, about 1¼ tons of red clover and timothy are obtained.

Good management can be accomplished rather easily by correct choice and rotation of crops, use of fertilizer and lime, and measures for improving moisture and tilth conditions. If other management requirements are met, the soil can be conserved under a rotation including a row crop once in 2 or 3 years. Most of the common field crops are fairly well suited to the soil with the possible exception of such deep-rooted legumes as alfalfa. Alsike clover, white clover, and possibly red clover will do well. Tobacco is not well suited to the more poorly drained part. Legumes should have an important place in any rotation, for they increase humus and nitrogen and improve tilth conditions. In short rotations, winter oats are excellent winter cover crops; and if turned under early in spring, they are effective in supplying some humus and nitrogen.

Where legumes are grown lime is needed. Lime also increases yields of most other crops. Corn and small grains need complete fertilizers containing moderate quantities of nitrogen and large quantities of phosphorus. Tobacco requires similar fertilizers, but the proportion of potash should be somewhat higher. Potatoes and many other vegetables require essentially the same fertilization as tobacco. Legumes require phosphorus but less nitrogen, and other hay crops need complete fertilizers. Fertilizers and other amendments should be made in moderate applications to meet the immediate needs of the crop.

Care in the selection of correct moisture conditions for tillage is needed in order to prevent clodding or puddling of the surface soil. Surface drainage can be feasibly improved by the use of shallow open

ditches in some places, but it is doubtful that yields or use suitability of the soil would be sufficiently improved by tile drains to justify the cost of their construction.

Leadvale silt loam, sloping phase.—This phase occurs on imperfectly drained fans and benches at the foot of hills, chiefly in shale valleys. Its parent materials are colluvium and local alluvium washed or rolled from the adjoining upland slopes. The soil was developed under a mixed forest of oak, hickory, sourwood, and dogwood, with considerable pine on the less favorable sites. Slopes range from 8 to 15 percent but are usually less than 10 percent. Surface drainage is moderate, but internal drainage is rather slow because of the hardpan layer.

An aggregate area of 713 acres is mapped. Most of it is in long narrow strips lying between the stream bottom lands and the uplands in Caney Valley. It is associated chiefly with Montevallo and Lehev soils and to a small extent with Armuchee soil on the uplands and with the normal phase and Philo soils on the colluvial lands and bottom lands, respectively. It also is in the valley of Big Sycamore Creek in association with similar soils and with Monongahela and Tyler soils on the adjoining terrace lands. A small acreage in Powell Valley is associated in a complex pattern with soils of the colluvial lands, terrace lands, bottom lands, and valley uplands.

Although this soil is similar to the normal phase, it has lost part of the original surface layer through accelerated erosion; and more rapid surface drainage is because of the stronger slopes. The surface 6 to 10 inches is grayish-brown or grayish-yellow moderately friable heavy silt loam. It is strongly acid in reaction and low in organic matter. Good tilth is moderately difficult to maintain because of the eroded condition, acidity, and low humus content. Moisture conditions are generally favorable for plant growth, but the upper soil may become saturated with water during prolonged or heavy rains. Most of the soil is stone-free, but small sandstone fragments are on the surface in a few places.

The subsoil is yellow to light brownish-yellow light silty clay to silty clay loam with a weakly developed nut structure. It contains some small soft black concretions in the lower part and is 10 to 15 inches thick. It is underlain by a semicemented hardpan—this is yellow silty clay heavily mottled and streaked with brown and gray. It is rather compact in place but shatters easily when moved. Water moves slowly through this layer, causing saturation of the surface soil and subsoil during wet periods and subsequent erosion. This layer is of variable thickness and may be underlain by either silty colluvium from the adjoining uplands, shale, or shaly limestone bedrock.

The chief variations are due to differences in texture and in the degree of erosion. In a few places practically all the original surface soil is missing, and the present plow layer is in the upper subsoil. In many places the alluvial layer is thin, and shale bedrock is at a depth of 3 feet or less. Near Brushy Ridge the soil has a fine sandy loam surface soil and a corresponding lighter subsoil. In Powell Valley the soil contains some limestone material and is possibly somewhat heavier in texture. Some of these variations, especially those caused

by erosion, may create local variations in the management requirements.

Use and management.—The present use of Leadvale silt loam, sloping phase, is similar to that of the normal phase. It is used rather intensively, and management practices are not designed to correct or improve unfavorable soil conditions to any great extent. Practically all the soil is cleared; probably half or more is used for growing row crops—chiefly corn with smaller acreages of burley tobacco and vegetables, and most of the rest in hay crops—chiefly lespedeza, with a small acreage that is idle or abandoned because of severe erosion. A few of the better farmers use a rotation of a row crop, small grain, and hay; but in many places row crops are grown for several years in succession followed by a few years of hay. Burley tobacco receives moderate to large applications of commercial fertilizer, but corn and small grains are fertilized only lightly and hay crops ordinarily not at all. Very little of the soil is limed at periodic intervals. No special practices for preventing erosion are used. Under common practices of management, acre yields of about 23 bushels of corn, 13 bushels of wheat, 675 pounds of burley tobacco, and between $\frac{1}{2}$ and $\frac{3}{4}$ ton of lespedeza may be expected.

Requirements for good management are similar to those for the normal phase, but more practices for preventing erosion are needed. If other management requirements are met, the soil can be conserved under a rotation including a row crop once in 3 or 4 years. A rotation of a row crop followed by small grain seeded to a legume or legume-grass mixture is well suited to the soil. It is fairly well suited to all the crops commonly grown in the county with the probable exception of deep-rooted legumes as alfalfa. Such legumes as alsike clover, red clover, white clover, and possibly crimson clover will do fairly well; and they should have an important part in any rotation, for they increase the nitrogen and humus supplies and improve tilth and moisture conditions. Barnyard manure is another important source of organic matter and nitrogen and contains some potash in addition, but it should be used in conjunction with phosphate fertilizer to obtain the correct balance of plant nutrients.

To insure success with legumes, it is necessary to neutralize soil acidity by applying ground limestone, which also supplies calcium to plants and aids in improving tilth and moisture conditions. Corn and small grains need complete fertilizers containing small to medium quantities of nitrogen and potash and relatively large quantities of phosphorus. Requirements of burley tobacco are similar, but more potash is required. Legumes or legume-grass mixtures require potash and phosphorus but ordinarily no nitrogen. The needs of potatoes, tomatoes, and many other vegetables are similar to those of tobacco. Moderate applications of lime and fertilizers to meet the immediate requirements of the crops are preferable to applying large quantities at infrequent intervals. Where suitable crops are correctly rotated and properly fertilized, tilth and moisture conditions are greatly improved and surface runoff and erosion are greatly reduced; but contour tillage is a good practice, and properly constructed and maintained broad-base terraces may possibly be useful in conserving moisture and preventing erosion.

LEHEW SERIES

The Lehew soils are moderately stony shallow sandy soils on sharp steep ridges. They are associated chiefly with Montevallo and Muskingum soils on the uplands and with Leadvale and Philo on the adjoining colluvial lands and bottom lands. Native vegetation was a mixed hardwood and pine forest. These soils are on the sharp comby ridges in the southeastern part of the county. About 97 percent of the area is steep and the remaining 3 percent hilly. About a fourth are cleared and have lost a large part of the original surface soil through erosion.

These soils do not have a distinctly developed profile. The surface soil is brown or purplish-brown fine sandy loam 6 to 8 inches thick underlain by purple shaly or stony fine sandy loam. Purple and red interbedded shale and sandstone bedrock is at a depth of less than 2 feet in most places.

Although these soils are less acid and more fertile than other shallow sandy soils of the county, they are poorly suited to either crops or pasture because of the steep slopes, stoniness, and poor moisture conditions and therefore are best used for forest. Only two types, the fine sandy loam and its hilly phase, are mapped.

Lehew fine sandy loam.—Areas of this soil occupy 9,470 acres on the steep slopes of sharp-crested comby ridges and the crests of valley mountains. The parent material was weathered from interbedded red, purple, and green acid shale and sandstone of the Rome formation and from purple and yellow slightly calcareous thin-bedded shale and sandstone of the Sequatchie formation (9). The soil was developed under a mixed hardwood and pine forest. Slopes range from 30 to 60 percent but are usually nearer 60 percent. Surface drainage is very rapid and internal drainage rapid.

Long continuous strips of the soil occur on slopes of Comby Ridge and Sycamore Knobs and along the Clinch River. In these places it is associated with Montevallo soils on the uplands and Leadvale and Philo soils in the colluvial lands and bottom lands. It also is in narrow bands immediately below the crests on the northwest-facing slopes of Powell and Lone Mountains and Wallen Ridge and on the southeast-facing slopes of Poor Valley Ridge. In these places Arnuchee soils are on the mountain slopes below and Muskingum soils on the crest and opposite slopes.

Under forest, the 6- or 8-inch surface layer is brown or purplish-brown friable fine sandy loam that is darkened by organic matter in the upper 2 inches. The soil is strongly acid but is generally less so than the Muskingum and Montevallo soils. Moisture conditions are relatively poor because of the rapid surface runoff and the low water-holding capacity. Blocky purple or red sandstone fragments are on the surface and in the soil.

The subsoil is a mixture of partly weathered blocky fragments of red, purple, and green shale and sandstone and brown or purplish-brown fine sandy loam soil material. This layer is less than 2 feet thick in most places and is underlain by red and purple thin interbedded sandstone and shale. In some places near the crests of ridges, sandstone outcrops on the surface.

As mapped, several variations are included. Where cleared, much of the original surface soil is missing; and the present plow layer is in the upper part of the original subsoil. In some places on the southeast slopes of Comby Ridge the soil is similar to the Muskingum soils and has a dominantly brownish-yellow or yellow subsoil. These areas are mingled with the fine sandy loam in a complex pattern, and it was not practical to delineate them on the soil map. On the crests of Wallen Ridge and Powell and Lone Mountains the soil is a silt loam; the underlying rocks contain thin beds of limestone or calcareous shales; and the soil is slightly more fertile than typical—it is similar to the Upshur soils of southwestern Virginia. On the northwest-facing slopes of Comby Ridge and Sycamore Knobs much of the soil has slopes of 70 percent or more. None of these variations is sufficient to alter materially the use suitability or management requirements.

Use and management.—The present use and management of Lehew fine sandy loam are variable. About 25 percent of the soil is cleared and used for corn, hay, and pasture; and the remaining 75 percent is in forest. Corn is grown for 1 or 2 years, after which the soil lies idle for several years and broomsedge, other wild grasses, and various scrubby trees become established. Some of the fields are pastured, but in general they are not used at all. Where hay is grown, lespedeza is the chief crop. Fertilizers and amendments are not ordinarily used, and crop yields are very low. Some of the soil on Powell Mountain and Wallen Ridge is used for pasture in conjunction with the associated Armuchee soils. Lime and phosphorus are used in some places, and both quality and quantity of pasture are better than on the unfertilized soils.

Most of the soil on Sycamore Knobs is in the Norris Reservation, where most of the land has been reforested. All the forested area has been logged; and the present timber is largely small second-growth and cull trees, mostly shortleaf pine with some hardwoods—chiefly oak. Other than in the Norris Reservation, no special forestry management methods are ordinarily used.

Because of the steep slopes, shallow soil, stoniness, and unfavorable moisture conditions this soil is poorly suited to either crops or pasture but is best used for forest. Some of it, however, that is closely associated with the Armuchee soils on Powell Mountain and Wallen Ridge is apparently more fertile and has more favorable moisture conditions. Some of these areas can be used in conjunction with the Armuchee soils for pasture purposes, and management requirements will be similar to those for Armuchee silt loam, steep phase. The soil that is now in forest should remain in forest, and most of the cleared areas should be reforested. The forest management requirements are similar to those of other shallow soils with steep slopes.

Lehew fine sandy loam, hilly phase.—This phase is on the milder slopes of comby ridges in association with the normal phase and the Montevallo soils. The soil is mapped on 319 acres in small areas on foot slopes. It is similar to the normal phase and has essentially the same profile, but it differs chiefly in having slopes of 15 to 30 percent. Moisture conditions may be slightly better because of the milder slopes, but, otherwise, conditions for plant growth are similar in the two soils.

No significant variations are included other than those caused by differences in erosion.

Use and management.—The present use of Lehigh fine sandy loam, hilly phase, is variable. Most of it is cleared; part is used for corn and hay, but much is idle or abandoned. Improved farming practices are not generally used, and yields are very low.

Use and management requirements are determined largely by the use and management of the associated soils. Where the soil is in sufficiently large areas to warrant the expense of fencing, it may be profitably used for pasture; and management requirements will be similar to those for the Armuchee soils. Much of the soil, however, is in small areas associated with nonagricultural soils, and forestry is its best use.

LIMESTONE ROCKLAND (ROLLING)

Limestone rockland (rolling) is on gently rolling to strongly rolling upland slopes in limestone valleys. It is underlain chiefly by high-grade slightly clayey limestone of the Black River formation and to a lesser extent by slightly or moderately cherty limestone of the Stone River formation. Native vegetation was a forest chiefly of redcedar with some post oak, blackgum, persimmon, and other hardwoods that are adapted to poor moisture conditions. Slopes range from 5 to 30 percent, but are usually more than 15 percent. Surface runoff is rapid on all but the mildest slopes, and internal drainage is moderate.

A total of 5,287 acres is mapped, the largest areas of which are in Cedar Fork Valley in tracts of 100 acres or more. It is associated chiefly with Rolling stony land (Talbot soil material), with small areas of Ooltewah silt loam in some of the larger lime sinks, and with small or medium-sized areas of Dewey cherty silt loam. It also is in Powell Valley and the valley of Little Sycamore Creek, chiefly in small or medium-sized areas associated with Rolling stony land (Talbot soil material) and Dewey and Talbot soils.

Outcrops on this land type differ from those on Rolling stony land (Talbot soil material) both in quantity and nature. On the rolling stony land outcrops cover half or less of the land surface in most places and are generally low and relatively narrow with fairly wide strips of material resembling Talbot soil material between; whereas the outcrops on this type cover 75 percent of the land area and protrude above the surface in large masses with narrow strips of material similar to the Colbert soil in the intervening spaces. This soil material is chiefly almost black or dark-brown heavy silty clay from a few inches to 1 or 2 feet thick. It is high in organic matter, and simple chemical tests indicate that it is acid even though it is shallow over limestone bedrock. Cracks and crevices in the underlying rock permit free movement of water, and leaching proceeds at practically the same rate as in normal soils.

Because surface runoff is moderately rapid and the soil material is shallow with a low absorptive capacity, moisture conditions for plant growth are very poor. Other than the relatively wide range of slopes and local differences in the number and kind of outcrops, this mapping separation includes no significant variations.

Use and management.—Practically all of Limestone rockland (rolling) is in a redcedar forest with some of the more drought-resistant hardwoods in the more favorable sites. Some of the less rocky areas

are partly cleared and used for pasture. On the better sites fair quality pastures are obtained early in spring and late in fall, but they are very poor during the rest of the year.

The requirements for good use and management vary from place to place depending upon local variations in the number of outcrops, the quantity of the land on any given farm, the kind and extent of other soils on farms, and other economic and social factors. In general, the land has so many unfavorable properties that it is not suited to use as either cropland or pasture land and is therefore limited to forest use; even though the kinds and yields of forest are much poorer than on most other land types and soils. The chief forest management problems are concerned with preventing forest fires and with the removal of weed trees that might compete with the more desirable species for the limited moisture and plant nutrient supplies. Under certain conditions it may be practical to use some of the more level, less rocky sites for pasture. On this land intensive practices will not be profitable, and the land should be used as nearly as possible in its natural condition. Removal of most of the trees and seeding to suitable pasture plants are probably the only special practices that can feasibly be used on the best sites; whereas clearings alone may be the only advisable step on others.

LIMESTONE ROCKLAND (ROUGH)

Large limestone outcrops and boulders cover much of the surface of Limestone rockland (rough). This rockiness, together with the steep or precipitous slopes of 30 to 60 percent, makes the use of this land impossible or impractical for anything other than forest. Surface runoff is very rapid. Originally, thin forest stands of redcedar, pine, and some of the more drought-resistant hardwoods—including post oak, blackjack oak, and blackgum—covered the land.

Most of this land type is on the bluffs along the Powell River in the northeastern part of the county associated with Limestone rockland (rolling) and Rough stony land (Talbot soil material). It also is in one large continuous area of several hundred acres on Newman Ridge. Small areas are along some of the streams in the limestone valleys and cherty ridge sections of the county. The aggregate area mapped is 2,483 acres.

This land differs from Limestone rockland (rolling) in several respects. It is on steeper slopes, the proportion of outcrops is greater, the outcrops are generally larger, the rocks are chiefly cherty dolomite rather than high-grade limestone, and the small quantities of soil materials more nearly resemble the Clarksville and Fullerton soils than the Colbert. It differs from Rough stony land (Talbot soil material) chiefly in that the rock outcrops are more numerous and more rugged and the slopes are generally steeper.

Use and management.—Moisture conditions and other factors affecting plant growth are unfavorable on Limestone rockland (rough). At present, practically all the land is in a forest of redcedar and small stunted hardwoods. Most of these trees have little value as timber, and in many places they are inaccessible and difficult or impossible to harvest. Although the forest is of very poor quality, the land is suited to no other use and the present use should be continued. Special forestry management practices cannot be profitably used, although

forest fires should be prevented both as a measure for protecting adjoining forest on better lands and as a means of preserving the forest that has some value in preventing excessive runoff from the steep slopes.

LINDSIDE SERIES

The soil of Lindsides series is on the imperfectly drained nearly level bottom lands along the small streams in the limestone valleys. It is associated chiefly with Melvin and Roane soils in the bottom lands and with various soils of the colluvial lands derived chiefly from limestone material. Small areas also are along streams in the cherty ridge sections.

Although this young soil does not have a definitely developed profile, the 8- to 12-inch surface layer is light-brown or grayish-brown silt loam underlain by mottled gray silty clay loam or silty clay. The underlying stream alluvium is chiefly heavy material washed from uplands underlain by limestone, but layers of sand and gravel are in many places. Limestone or cherty dolomite bedrock is at depths of several to many feet. One type, the silt loam, is mapped.

Lindsides silt loam.—Parent materials of this soil are derived chiefly from alluvium washed from uplands underlain by limestone, but part of the soil is derived from dolomitic materials, shale, and sandstone. The soil was developed under a hardwood forest of water-loving oak, maple, beech, and sweetgum. Slopes are less than 3 percent. Surface drainage is moderate but internal drainage is slow.

The soil is chiefly in long narrow strips along the streams that drain the valley of Little Sycamore Creek and Powell and Cedar Fork Valleys. Melvin silt loam is the chief associated soil in the bottom lands, and various limestone soils are on the adjoining uplands. Small areas also are along some of the larger streams in the cherty ridge sections in association with Melvin and Roane soils in the bottom lands, Greendale soils on the colluvial lands, and chiefly Clarksville and Fullerton soils on the uplands.

This young soil does not have a definitely developed profile. The surface 8 to 12 inches is grayish-brown or light-brown heavy silt loam. Reaction is slightly to medium acid, and the organic-matter content is low to medium but is generally higher than that of the adjoining upland soils. Good tilth is moderately easy to maintain, although the soil becomes cloddy or puddled if tilled when too wet and tillage operations may be seriously impeded.

The gray subsoil is silty clay loam or silty clay heavily mottled with yellow and brown. Moisture moves through this layer slowly and it is usually saturated with water. At a depth of 12 to 36 inches it is underlain by heavy dominantly gray stream alluvium chiefly from limestone material containing some layers and beds of sand and gravel. Limestone or cherty dolomitic bedrock is at a depth of a few to many feet.

The chief variations are in the thickness of the surface and other layers. Areas along the streams in the cherty ridge section are somewhat lighter in texture and have a small quantity of chert in the surface layer and a relatively large quantity in the underlying alluvium. One or two small areas of a well-drained brown soil are included.

Use of management.—The present use and management of Lind-

side silt loam vary from place to place, but in general they are not well adjusted to the physical properties of the soil. Practically all the soil is cleared—about 40 percent is used for corn, and the rest is in hay and pasture with small acreages of small grains and other crops. Practically no lime, fertilizer, or other soil amendments are used, but in a few places open ditches are used to remove excess surface water. Under current practices of management, corn yields about 35 bushels an acre; wheat, 11 bushels; lespedeza, 1 ton; and timothy and clover, 1½ tons.

Requirements for good management are comparatively simple, although the kinds of crops that can be grown are limited by imperfect drainage. Corn, soybeans, lespedeza, redtop, alsike clover, and red clover do fairly well; but the soil is not well suited to growing burley tobacco, alfalfa, barley, and other crops that have deep root systems or require good drainage. Row crops can be grown continuously without seriously injuring the soil, but short rotations are generally more practical from the standpoint of good farm management. Winter cover crops are needed to prevent scouring or washing of the soil by overflow waters and to supply humus and nitrogen when plowed under in spring. Where such a practice is followed, corn and other crops may not require additional supplies of nitrogen, but phosphorus and possibly potash will probably give profitable increases in yields. Lime may be necessary to obtain good stands of legumes, but the need for lime should be determined by means of simple soil tests, inasmuch as part of the soil may be fairly well supplied with lime. Surface drainage can be improved by the use of open ditches. Tile drains may be useful in some places, but they should not be constructed without careful planning by a competent engineer.

MELVIN SERIES

The soil of the Melvin series is on level, imperfectly drained bottom lands along the small streams of the limestone valleys. It is closely associated with the Lindside soil and is underlain by young stream alluvium washed largely from uplands underlain by limestone material. Areas are in the limestone valleys, and small acreages also are in some of the cherty ridge sections.

Although this soil does not have a definitely developed profile, the upper layer is dominantly gray silt loam containing brown splotches. It is underlain by heavy gray or bluish-gray material mottled with yellow and rust brown, which in turn is underlain by heavy gray stream alluvium chiefly from limestone material containing beds or lenses of sand and gravel. The silt loam is the only type mapped.

Melvin silt loam.—This soil is on slopes of 1 to 2 percent along small streams. The parent material is derived from young stream alluvium washed largely from uplands underlain by limestone material, although part of the soil in the cherty ridge section is derived chiefly from dolomitic materials. Native vegetation was a water-loving hardwood forest with some willow, cattails, sweetflag, and various sedges in some of the wettest places. Both surface and internal drainage are very slow, and the soil is subject to annual overflow. Small areas of the 508 acres mapped are along the streams that drain Powell and Cedar Fork Valleys and the valley of Little Sycamore Creek in close association with Lindside silt loam in the bottom lands

and with various limestone soils on the adjacent uplands. Small areas also are along some of the larger streams in the cherty ridge section in association with Roane and Lindsides soils on the bottom lands and with Clarksville and Fullerton soils on the nearby uplands.

This young soil does not have a distinctly developed profile. The surface 6 to 12 inches is gray heavy silt loam containing splotches of brown. It is medium acid in reaction and low in humus but in many places may contain partly decomposed plants.

The gray or bluish-gray subsoil is heavy silty clay loam or silty clay containing yellow and rust-brown mottlings. Soft brown or black concretions may be present. This layer is variable in thickness and is underlain chiefly by heavy gray stream alluvium washed largely from limestone materials, but in places there are some sandy or gravelly layers. Limestone or cherty dolomite bedrock is at depths of several feet.

The chief variations are due to differences in the thickness of the various layers and the color and degree of mottling. Locally the surface soil may be silty clay loam or silty clay. Areas in the cherty ridge section may have some chert on the surface and in the soil. A few small spots are very poorly drained and could be separated as a swampy phase if they were of sufficient extent.

Use and management.—The present use and management of Melvin silt loam vary from place to place, but they are not generally well adjusted to the physical properties of the soil. Most of the year the soil is too wet to permit ordinary tillage operations, and only plants that can thrive on soils saturated with water can be expected to do well. Practically all of it is cleared; most of it is used for pasture, but some corn and a small acreage of wheat are grown on some better drained areas. Lime, fertilizer, and other amendments are never used. In a few places attempts are made to improve surface drainage by the use of open ditches. Corn and wheat yields are low, and pasture is relatively poor in quality and low in yields.

Requirements for good management are concerned chiefly with using lime and fertilizer and improving drainage for suitable pasture plants. Bluegrass, white clover, alsike clover, common lespedeza, and redtop may be expected to do fairly well. A mixture of bluegrass and white clover makes an excellent pasture if fertilized with phosphorus and lime. Lespedeza and redtop stands can be obtained with little or no amendments; but the quantity and quality of pasture is poorer, and it will soon be crowded out by various wild grasses and weeds. Weeds should be removed by clipping. Surface drainage can be improved by open ditches, but tile drains are so costly that their use is not likely to be profitable. Improved surface drainage increases the length of the grazing periods. The wettest part of the soil is not suited to tame pasture and should be allowed to remain in natural vegetation.

MINE DUMPS

Tailings and refuse from coal mines cover 92 acres in the Cumberland Mountain section. These materials consist chiefly of large piles of shale and other waste rock. At present they apparently have no economic value and destroy any value the land might have for growing timber. As mining operations continue the acreage of these wastelands will increase.

MONONGAHELA SERIES

The soil of the Monongahela series is on nearly level imperfectly drained old stream terraces well above the level of present overflow (pl. 10, *B*). It closely resembles the Taft soil, differing chiefly in that its parent material is derived from old alluvium washed from uplands underlain mainly by sandstone and shale rather than from limestone material. Native vegetation was a hardwood forest. All the soil is in the valley of Big Sycamore Creek.

The profile is similar to that of the Taft soil, but the texture of this soil is generally somewhat lighter. The grayish-brown to gray silt loam surface layer is underlain by a yellow or brownish-yellow heavy silt loam or light silty clay loam subsoil. A mottled gray and yellow hardpan is at a depth of 18 to 24 inches. The underlying material is heavy mottled gray stream alluvium. Acid shale bedrock is at a depth of several feet. Only one type, the silt loam, is mapped.

Monongahela silt loam.—The soil is on nearly level imperfectly drained old stream terraces. The parent material is of old stream alluvium washed largely from uplands underlain by acid shale. Some sandstone and limestone materials also are present. The soil was developed under a hardwood forest of oak, some hickory, gum, and sourwood. Slopes are less than 7 percent with the greater part having slopes of less than 3 percent. Both internal and surface drainage are somewhat slow. All of the 151 acres mapped is in the valley of Big Sycamore Creek in the general vicinity of Howard Quarter. It is associated with Tyler, Leadvale, Jefferson, Philo, and Atkins soils on the adjacent terrace lands, colluvial lands, and bottom lands, and with Montevallo, Muskingum, and Lehew soils on the nearby uplands.

The profile is similar to that of Taft silt loam, but the soil texture is generally somewhat lighter. The surface 6 to 8 inches is grayish-brown to gray silt loam. It is strongly or very strongly acid in reaction and low in organic matter. Good tilth is fairly easy to maintain; although if plowed or tilled when too wet, the soil puddles. Moisture conditions are generally favorable for most plants except certain deep-rooted legumes, as alfalfa, and certain other crops, including burley tobacco and barley. During heavy or prolonged rains, the surface layer becomes saturated with water, whereas during droughts it becomes very dry.

The 12- to 18-inch subsoil is yellow or brownish-yellow heavy silt loam or light silty clay loam with a weakly developed nut structure. It is underlain by a hardpan layer that is dominantly gray in color but is heavily mottled with yellow and brown. This layer is compact in place and is lightly cemented; it is relatively impermeable to water and impedes movement of moisture, which partly accounts for the alternate wet and dry conditions of the upper soil layers. The moderately heavy substratum of old stream alluvium is from a few to several feet thick and is underlain by acid shale bedrock. No significant variations are mapped.

Use and management.—All of Monongahela silt loam is cleared and is used chiefly for hay and pasture, although a small part is in tobacco, corn, and small grains. Lespedeza mixed with tame and wild grasses is the principal hay and pasture crop. Crops are allowed to remain for several years; and the soil is then planted to corn, burley tobacco,

or wheat for 1 or 2 years, after which hay crops are again seeded. Small applications of fertilizer are used on corn and small grains, but hay ordinarily receives none. Very little of the soil is ever limed. In a few places open ditches are used to remove excess surface water. Under current practices of management, acre yields of about 15 bushels of corn, 10 bushels of wheat, and $\frac{1}{2}$ ton of lespedeza or mixed hay may be expected.

Requirements for good management are comparatively simple, although the kinds of crops that can be grown are somewhat limited by imperfect drainage. Aside from proper selection and rotation of crops, the chief management requirements are concerned with the use of lime and fertilizer and some practices for improving moisture conditions. Inasmuch as the physical properties of the soil are similar to those of Taft silt loam, management requirements are essentially the same.

MONTEVALLO SERIES

The Montevallo soils are on the hilly and steep slopes of knobs and hills underlain by acid fissile shale (pl. 11, A). These soils are mapped in association chiefly with the Lehew soils on the uplands and with the Leadvale and Philo soils on the adjoining colluvial lands and bottom lands. Native vegetation was a mixed forest of hardwood and short-leaf pine. Areas are in the shale ridges in Caney Valley and the valley of Big Sycamore Creek. About 60 percent of the soil is steep and 40 percent, hilly. Most of the soil is severely eroded.

The soils do not have definitely developed profiles. In most places they have a thin light brownish-gray shaly silt loam surface soil a few inches thick underlain by a mixture of shale fragments and grayish-brown silty soil material. Variegated acid shale bedrock is at depths of 18 to 24 inches.

Because these soils are extremely acid, low in organic matter and fertility, poor in moisture conditions, and severely eroded, they are not suited to crops or pasture and are best used for forest. Management requirements are chiefly concerned with the use and management of forest. The soil is mapped in one type and one phase—the shaly silt loam and its hilly phase.

Montevallo shaly silt loam.—This soil is on steep slopes of 30 to 60 percent on the cone-shaped knobs and hills bordering shale valleys. It was developed from parent materials weathered from acid fissile shale chiefly of the Conasauga and Rome formations but also of the Chattanooga formation (13), (14). Native vegetation was a mixed forest of hardwood and pine. Both internal and surface drainage are rapid. A total area of 1,726 acres is mapped on the ridges on either side of Caney Valley and on hills and knobs in the valley of Big Sycamore Creek in association chiefly with the hilly phase and Lehew soils on the uplands and with Leadvale and Philo soils on the adjoining colluvial lands and bottom lands.

The profile is not distinctly developed. The surface 4 to 6 inches is loose open light brownish-gray shaly silt loam underlain by a mixture of yellow, red, purple, and green shale fragments and grayish-brown silty soil material. Variegated red, green, purple, yellow, and gray acid fissile shale bedrock is at depths of less than 2 feet in most places. Reaction is very strongly acid and organic-matter content very



A, Typical farm dwelling on the Montevallo-stony land-Leadvale association. Leadvale soils are in foreground and Montevallo soils on steep ridge in background. These soils are very poorly suited either to crops or to pasture, but under good management a small proportion is suitable for crops.

B, Recently cleared area of Muskingum stony fine sandy loam. Corn had been grown, but low yields resulted in abandonment of the field. Dead chestnut in foreground.



Close-up view of the surface of eroded Talbott soil. The drying of the silty clay loam material forms cracks. Heavy rains wash soil material into these cracks, cause the soil material to swell, and have a packing effect. This repeated shrinking, swelling, and packing is largely responsible for the unfavorable physical properties of the surface layer.

low. Moisture conditions for plant growth are poor because of the low water absorbing and retaining properties and the large loss of water in surface runoff. Where the soil is severely eroded, all the upper layers may be missing and shale bedrock is exposed at the surface. In such places, conditions for vegetative growth are extremely poor.

The chief variations are in the degree of erosion and the color of the underlying shale. One variation of considerable extent is in the valley of Big Sycamore Creek where the soil is underlain by black shale. In some places where the underlying rocks contain a few thin lenses and beds of limestone, the soil may be somewhat more fertile than normal; but in general the difference is not large enough to alter the physical use suitability. These areas resemble the Litz soils of southwestern Virginia.

Use and management.—Present use and management of Montevallo shaly silt loam are poorly adjusted to its physical properties. Practically all the soil has been cleared and used for growing crops at some time. Its natural fertility was soon exhausted, however, and most of the soil became severely eroded after being used for crops a few years. At present most of it is abandoned; thin stands of shortleaf or Virginia scrub pines are on many of the old fields, whereas broomsedge and brush are on others. On some of the more severely eroded areas, vegetation of any kind is very sparse. In some places the soil is used for growing corn and lespedeza. Fertilizers and amendments are not ordinarily used; yields generally are very low and become successively lower where the soil is used for crops year after year. Forest is poorly managed, and no practices to maintain or improve the forest stand are used. No attempts are made to control grazing or prevent fires, and in many places trees are cut as soon as they are large enough to yield one small plank.

Because of its eroded condition, steep slopes, low fertility, extreme acidity, and poor moisture conditions, this soil is not suited to either crops or pasture. It is best suited to forest, although both quantity and quality of timber is low as compared with that obtained on more productive soils. Areas now cleared should be reforested in order to stabilize the soil and to prevent further erosion and damage to adjoining colluvial and bottom lands by overwash. Some preparation of the soil may be necessary before trees can be successfully planted. Gullies can be controlled by check dams. Phosphate fertilizer may be beneficial to young trees. Varieties of pines are best suited, although hardwoods may do fairly well on some of the more favorable sites. After trees are planted, they should be protected from fire and grazing by livestock and some measures for control of insect pests and diseases may also be required. Systematic harvesting of timber is needed in order to remove undesirable and mature trees and insure a continued crop and income from the forest.

Montevallo shaly silt loam, hilly phase.—Areas of this phase are on hilly slopes underlain by acid fissile shale chiefly of the Conasauga formation but also of the Rome and Chattanooga formations (13), (14). Slopes range from 15 to 30 percent, and both surface and internal drainage are rapid. The soil is on the ridges and knobs bordering Caney Valley and on low knobs and ridges in the valley of Big Sycamore Creek. The aggregate area of 1,272 acres usually is in small or

medium-sized areas on the lower slopes and benches, with the normal phase and Lehigh soils on the adjoining uplands and with Leadville and Philo soils on the adjacent colluvial and bottom lands. Native vegetation was a mixed forest of oak, blackgum, some hickory, and short-leaf pine.

The profile is similar to that of the normal phase, but more of the upper layers of this phase have been removed by erosion because of more intensive use. The upper few inches are loose open brownish-gray shaly silt loam. This is underlain by a mixture of variegated acid shale and grayish-brown silty soil material. Red, purple, green, yellow, and brown shale bedrock is at a depth of less than 2 feet. Where the soil is more severely eroded, the shale bedrock is exposed at the surface in many places. The soil is very low in organic matter, extremely acid in most places, and very low in phosphorus and nitrogen. Moisture conditions for plant growth are very poor because of the large losses of water in surface runoff and the low water-holding capacity of the soil.

Several variations are mapped. On the lower slopes of some hills the underlying rocks contain thin beds of shaly limestone, and the soils resemble those of the Litz series of southwestern Virginia. In the valley of Big Sycamore Creek the soil is underlain by black shale. A few small areas on the tops of hills have slopes of less than 15 percent. Other small areas with a heavy, sticky, plastic subsoil are on the slopes along the south end of Straight Creek in the southern part of the county and on the lower slopes of the west end of Powell Mountain. None of these variations is of sufficient extent to significantly alter the use suitability of the soil.

Use and management.—As with the normal phase, the present use of Montevallo shaly silt loam, hilly phase, is very poorly adjusted to the physical characteristics of the soil. At present practically all the soil is cleared, and most of it has been cultivated at some time. Much of the soil is now abandoned; but some is used for growing corn, hay, and pasture. Where it is used for growing corn, plowing is the only special preparation made; this is usually done on the contour, largely from necessity. Common lespedeza is grown by a few farmers, but hay and pastures are largely a mixture of broomsedge and other volunteer or wild grasses. Fertilizers or other amendments are not ordinarily used on either crops or pastures, and yields are very low. After a few years' use as cropland or pasture land under common management, yields become so low that the soil is abandoned. Some of the more severely eroded abandoned fields are devoid of any kind of vegetation, but thin stands of Virginia scrub pine, persimmon, and broomsedge are in most places. Most of the fields are entirely idle, but a few farmers use them for grazing purposes.

In general, conditions for plant growth are so poor that the soil is not suited to use as either cropland or pasture land. Although some areas that contain small quantities of limestone materials in the underlying rock are normally somewhat more fertile, they were so poorly managed in the past that they are now severely eroded and their present productivity is very low. The best use for the soil is forest; forest management requirements and practices are similar to those for the normal phase.

MUSKINGUM SERIES

The light-colored Muskingum soils are the shallow sandy acid soils on the slopes of the even-crested mountain ridges underlain by light-colored massive sandstone and conglomerate (pl. 11, *B*). These soils occupy about 18.6 percent of the county area. They are in broad areas associated chiefly with Rough stony land (Muskingum soil material) in the uplands but also with the Lebew and Montevallo soils in the Great Valley section. Jefferson, Leadvale, Pope, and Philo soils are on the adjoining colluvial and bottom lands. One large almost continuous area occurs in the Cumberland Mountain section, but smaller ones are on the mountains of the Great Valley section. Most of the soil is stony, and nearly all of it is in forest. Very little of the area is eroded. About 92 percent of it is steep and 8 percent, hilly.

These soils do not have well-developed profiles. Typically the surface soil is grayish-yellow or yellow stony fine sandy loam underlain by a brownish-yellow fine sandy clay subsoil. Massive acid sandstone or conglomerate bedrock is at shallow depths of less than 3 feet in most places.

Because of steep slopes, shallow depth to bedrock, low inherent fertility, and stoniness, these soils are of little agricultural importance. They are poorly suited to either crops or pasture and can best be used for forest. Although the rate of growth and quality of timber is likely lower than on the more fertile soils, the use and management of the soil are concerned almost entirely with forestry practices. The stony fine sandy loam and its deep phase are mapped.

Muskingum stony fine sandy loam.—A shallow soil on steep mountain slopes underlain by acid sandstone, conglomerate, and shale. In the Cumberland Mountain section these rocks are of the Lee, Briceville, Scott, and Anderson formations; and some contain coal beds. On Powell Mountain and Wallen Ridge the underlying rocks are massive fine-grained sandstones of the Clinch formation (9), (14); whereas on Poor Valley Ridge the rocks are of the Clinton formation. Native vegetation was a mixed hardwood forest of oak, hickory, chestnut, and yellowpoplar. On Cumberland Mountain some linden, beech, maple, and walnut were on the lower slopes where moisture conditions were more favorable, but on the more droughty sites shortleaf and Virginia pines were present. Slopes range from 30 to 60 percent, with much of the relief being 40 to 45 percent in gradient. Both surface and internal drainage are rapid.

This is the most extensive soil type in the county, occupying 17.1 percent of the county area, or 47,609 acres. The soil is in one large almost continuous area of about 36,000 acres in the Cumberland Mountain section. It is associated with the deep phase and Rough stony land (Muskingum soil material). Pope, Philo, and Atkins soils are on the adjoining bottom lands and Jefferson soils are on the colluvial lands. In the Great Valley section the soil is in long continuous strips on the southeast-facing slopes of Powell and Lone Mountains and Wallen Ridge and on the northwest-facing slopes of Poor Valley Ridge. Lebew and Montevallo soils are on the nearby uplands and Philo, Leadvale, and Jefferson are in the bottom and colluvial lands.

Like other shallow soils the profile is not well developed, but the following description obtained on Cumberland Mountain in the north-

western part of the county is representative of much of the soil. A thin layer of forest litter 1 or 2 inches thick is on the surface, and many flat slabs of sandstone are in places. The upper 2 inches of soil is a loose gray fine sandy loam stained in the upper part with organic matter. This layer is heavily matted with fine tree roots. The next 6 inches is grayish-yellow or yellow stony fine sandy loam that is very strongly acid in reaction and low in organic matter. Roots and air move freely through the soil, but moisture conditions are only fair because of the open, porous nature of the soil and the steep slopes.

The brownish-yellow fine sandy clay subsoil contains a large quantity of sandstone fragments. The lower part of the layer is mottled with red, brown, and gray. At a depth of about 16 to 24 inches it is underlain by massive sandstone or conglomerate bedrock that may contain some shale layers in places. The rock floor is uneven, and surface outcrops and ledges are in many places.

Several variations are mapped. In cleared areas most of the original surface soil is missing, and the original subsoil is now at the surface. On Brushy Ridge in the valley of Big Sycamore Creek the soil has a heavy clayey subsoil under the sandy surface layer. On the west ends of Powell Mountain and Skaggs Ridge a few small areas that resemble the Hector soils have a red subsoil. On the north slope of Poor Valley Ridge the soil has a reddish subsoil owing to the presence of iron ore in the parent material and underlying rocks. On Cumberland Mountain small or medium-sized areas of Muskingum stony fine sandy loam, deep phase, and Rough stony land (Muskingum soil material) are included because the heavy forest growth and rough relief made close traverse of much of this mountain area either impractical or impossible. None of these variations is of sufficient extent to alter materially the use suitability or management of the soil.

Use and management.—Probably more than 95 percent of Muskingum stony fine sandy loam is in forest, but a small acreage is cleared and used for growing corn and pasture. In general no management practices other than plowing, cultivating, and harvesting are used; and yields are very low even on newly cleared areas. The low inherent fertility is soon exhausted, and the soil is abandoned after a few years.

Forest management practices are variable. In the Great Valley section much of the soil is owned in relatively small tracts. All the first-class timber has been cut, and timber is now harvested as frequently as merchantable trees mature. The present stands are poor in both quantity and quality; they contain a relatively large proportion of small and cull trees of the less useful species. Much of the present timber is injured by fire, inasmuch as few precautions for fire control are used.

Forest in the Cumberland Mountain section is better managed. Land in this area is owned largely by one corporation. Most of the timber is cut under contract, and selective cutting is practiced—trees of less than 16 inches in diameter at breast height are left. Harvesting timber is carefully checked by frequent visits of representatives of the landowners to all logging operations. All the logs cut in the valley of Tackett Creek are hauled to Duff in Campbell County where they are sawed by a band mill into railroad ties, heavy timbers for construction

purposes, and rough lumber. In the rest of the area logs are hauled by teams or trucks to portable mills where they are sawed into cross ties, lumber, and mine timbers. Measures for prevention and control of forest fires are used, but a few severely burned areas are in the forest. Practically all the first-class trees have been harvested. Present stands consist largely of small or second-growth oak and yellow-poplar with some linden, beech, maple, and hemlock in the more favorable sites.

Inasmuch as the soil is suited to neither crops nor pasture because of its steep slopes, low inherent fertility, stoniness, and poor moisture conditions, it is best used for forest. Management requirements are concerned chiefly with the conservation and use of forests and are discussed in the section on forests. In general, the soil can be more advantageously used and managed where it is in large tracts under single ownership rather than in small tracts, but many economic, sociological, and other factors affect use and management and must be considered before definite recommendations for specific areas can be made.

Muskingum stony fine sandy loam, deep phase.—This phase is very similar to the normal phase, but the relief is milder—slopes range from 15 to 30 percent. It was developed from similar parent material on mountains underlain chiefly by sandstone under a similar type of forest. Moisture conditions are possibly slightly more favorable because of the milder slopes, but both internal and surface drainage are rapid. More of the soil is cleared, and consequently more of the original surface soil has been lost through erosion.

Small areas of this soil are on the hilly tops and foot slopes of Cumberland Mountain associated with the normal phase and with Jefferson, Pope, Philo, and Atkins soils. It is in moderately large areas on Brushy and Skaggs Ridges in the southeastern part of the Great Valley section. The aggregate area mapped is 4,103 acres. Included variations are comparable to those of the normal phase.

Use and management.—Present land use and management are poorly adjusted to the physical properties of Muskingum stony fine sandy loam, deep phase. Most of the soil is cleared and used for growing corn, hay, and pasture. No improved management practices are ordinarily used: Crops are not rotated, fertilizers and amendments are not used, and no attempt is made to control runoff and prevent erosion. Yields are very low and become progressively lower under prevailing systems of management. When the low natural fertility is exhausted the soil is abandoned and grows up in Virginia scrub pine. Where most severely eroded the abandoned soil has little vegetation of any kind, but in other places broomsedge and brush soon become established. Forest management is the same as that on the normal phase.

Although moisture conditions are slightly better than in the normal phase, this soil is not suited to either crops or pasture because of strong slopes, stoniness, shallowness to bedrock, and low inherent fertility. It therefore is best suited to forest, and its forest management requirements are essentially the same as those for the normal phase.

OOLTEWAH SERIES

The soil of the Ooltewah series is in the bottom of relatively small, shallow, nearly level lime sinks. Most of it is in Powell Valley, but small areas are in all the limestone valleys. The soil is generally free of chert and stone, and none is eroded or susceptible to erosion. Although this young soil does not have a well-developed profile, in general, it has a light-brown or grayish-brown surface soil and a mottled gray subsoil. The parent material, derived from local alluvium and colluvium washed from the surrounding limestone uplands, is underlain at depths of several to many feet by limestone bedrock. Only one type, the silt loam, is mapped.

Ooltewah silt loam.—This soil is on the nearly level bottoms of small shallow lime sinks and depressions in limestone valleys. Its parent material was derived from local alluvium and colluvium chiefly from Dewey and Talbott soils, but materials from Fullerton and Clarksville soils are in some places. Native vegetation was a hardwood forest of oak, hickory, maple, and some willow. Slopes are from less than 1 to about 3 percent; hence there is practically no surface drainage because the soil is in depressions without outlets, and internal drainage is moderately slow. Most of the 523 acres mapped is in small circular or elliptical shaped areas in small depressions in Powell Valley. Dewey and Talbott soils are on the adjoining uplands, and the Guthrie soil is in the depressions. A few areas are in lime sinks in the cherty ridges west of New Tazewell near the head of Big Barren Creek and are associated chiefly with Clarksville and Fullerton soils.

This young soil does not have a well-developed profile. The surface 12 to 18 inches is light-brown or grayish-brown heavy silt loam. It is medium acid in reaction, and although it has low to moderate supplies of organic matter, it generally is higher in organic-matter content than the soils of the surrounding uplands. Soil moisture conditions are only fair, inasmuch as the soil is imperfectly drained and may be covered or saturated with water for several days after heavy rains. In spring the soil is cold and wet, and crop planting is delayed. Good tilth is moderately difficult to maintain because of the adverse moisture conditions, which may necessitate tillage when the soil is too wet and result in puddling or clodding. Most of the soil is free of stone or chert; but in some places some chert and limestone fragments are on the surface and in the upper part of the soil.

The subsoil is gray silty clay loam mottled with brown and yellow. It contains soft dark-brown and red concretions and is somewhat compact, sticky, and plastic. It is several feet thick and becomes lighter in color and heavier in texture with increasing depth. Limestone residuum or bedrock is at depths of several to many feet.

Several variations are mapped. The surface layer varies from 8 inches thick in some places to more than 30 inches in a few areas west of New Tazewell. A few small areas in the general vicinity of Arthur in Powell Valley have a heavy silty clay loam surface soil, and several areas are in cherty ridge sections rather than in limestone valleys. In places the brown surface layer is a very recent accumulation of material that has covered what was originally a poorly drained soil. None of these variations is of sufficient importance to affect materially the use suitability or management requirements of the soil.

Use and management.—The present use and management of Ooltawah silt loam are fairly well adjusted to the physical properties of the soil. All the soil is cleared and cultivated; corn, lespedeza, red clover and timothy, and wheat are the chief crops. Small acreages are used for garden vegetables and burley tobacco, and some bluegrass and white clover is in pasture. Crops are not systematically rotated; row crops are grown for several years followed by several years of hay. Some of the smaller areas are in fields with Talbott or Dewey soils and are managed in the same way as the adjoining upland soils. Small quantities of fertilizer are used on wheat and corn, and tobacco is fertilized heavily; but hay crops ordinarily receive no fertilizer. Very little of the soil is ever limed. No special practices for controlling water are used. Under common practices of management, acre yields of about 35 bushels of corn, 10 bushels of wheat, 900 pounds of burley tobacco, 1½ tons of timothy and clover, and 1 ton of lespedeza may be expected.

Although soil moisture conditions are not ideal, this soil is suited to intensive use because of moderate fertility and gentle slopes. Management requirements are relatively simple. The better drained areas are suited to corn; small grains; most hay crops, with the exception of alfalfa; and, in normal seasons, to burley tobacco. On the more poorly drained sections, the crops that can be grown are more limited. In these places corn, soybeans, possibly wheat, and certain hay and pasture crops—including lespedeza, crimson clover, white clover, and bluegrass—are among the crops best suited.

Short rotations, which should include a legume that if turned under is effective in increasing the nitrogen and humus content and improving the friability and permeability of the soil, can be used. Lime, phosphorus, and potash are needed by all crops. In general, fertilizers should be applied in moderate quantities to meet the needs of the individual crops rather than in large quantities at long intervals. Care should be taken to avoid tillage when the soil is too wet in order to prevent puddling and clodding, which would injure tilth and moisture conditions. Although the soil would undoubtedly be improved by artificial drainage, very little of it is in places where drainage can be accomplished. It is necessary therefore to use the soil only for crops that are suited to imperfect drainage conditions and to control moisture conditions as much as possible by tillage and cultural methods.

PHILO SERIES

Soils of the Philo series are on imperfectly drained bottom lands underlain chiefly by young stream alluvium washed from sandstone and shale materials. They are closely associated with the Pope and Atkins soils, but differ from the Pope soil chiefly in being less well drained and from the Atkins in being better drained. These soils are on Cumberland Mountain and the shale valleys and have nearly level relief. About 73 percent of them are practically stone-free, but the remaining 27 percent are stony enough to impede tillage.

These young soils do not have definitely developed profiles. The surface layer is light grayish-brown to brownish-gray silt loam or fine sandy loam. The subsoil is dominantly gray fine sandy loam mottled with brown and yellow. The underlying alluvium is from

acid rocks, either sandstone or shale depending upon the local source of materials. Bedrock is at depths of many feet below the surface.

Although the soils of this series are at least fairly well suited to crops, the kinds are limited by imperfect drainage. Management requirements are concerned chiefly with proper selection of crops, use of soil amendments, and improvement of drainage conditions. Two types of soil, the fine sandy loam and the stony fine sandy loam, are mapped in the county.

Philo fine sandy loam.—The parent material is derived from young stream alluvium washed from uplands underlain by sandstone and shale. Native vegetation was a mixed forest of beech, maple, elm, oak, sycamore, birch, willow, and hemlock with a heavy undergrowth of holly, rhododendron, and mountain-laurel. Slopes are less than 3 percent. Both internal and surface drainage are slow, and the soil is subject to overflow. Long narrow strips occur along Tackett and Clear Fork Creeks on Cumberland Mountain in association with Pope and Atkins soils in the bottom lands and Muskingum soils on the adjacent uplands. Relatively broad areas are in the valley of Big Sycamore Creek in association with various soils of the bottom lands and terrace lands including the Atkins, Holston, and Monongahela series. Muskingum and Lebew soils are on the adjacent uplands. Long narrow strips also are in Caney Valley in association with Leadvale soils on the colluvial lands and with Montevallo and Lebew soils on the nearby uplands. The aggregate area mapped is 2,137 acres.

This young soil differs from Pope fine sandy loam chiefly in being less well drained and from Lindside silt loam in being derived chiefly from sandstone and shale materials rather than limestone. The surface 8 to 12 inches is light grayish-brown friable fine sandy loam. It is low to medium in organic-matter content but is generally higher than the soils on the adjoining uplands. Reaction is strongly to very strongly acid. The soil is permeable to moisture, but during wet seasons it becomes saturated because of slow surface runoff and slow internal drainage. Good tilth is fairly easy to maintain except in areas with heavier surface soils that become puddled or cloddy if tilled when too wet.

The subsoil is gray fine sandy loam mottled with yellow and brown. It is about 2 feet thick and is underlain by stream alluvium consisting largely of beds of sands with some gravelly and silty layers in places. Bedrock occurs at depths of many feet.

As mapped several variations are included. The most important difference is in the shale valleys where most of the soil has a silt loam surface layer, a silty clay loam subsoil, and silty underlying alluvium washed largely from shale. In places in these valleys, the soil has a purplish cast because of the content of purple shale material. In the Cumberland Mountain section the soil is closely associated with Philo stony fine sandy loam, and in many places the boundary between the soils is arbitrarily drawn.

Use and management.—The present use of Philo fine sandy loam is fairly well adjusted to its physical properties, but management practices for compensating for soil deficiencies or improving it are not used. Practically all the soil is cleared—it is used chiefly for growing corn and hay, but small areas are idle. No system of

rotating crops is used; and ordinarily no lime, fertilizer, or other soil amendments are applied. Under current systems of management, acre yields of about 25 bushels of corn and $\frac{3}{4}$ ton of lespedeza or mixed hay may be expected.

Requirements for good management are comparatively simple and can be easily accomplished. The variety of crops that can be grown is limited by imperfect drainage. Corn, soybeans, sorghum, vegetables, possibly wheat, alsike clover, redbud, lespedeza, white clover, and bluegrass may be expected to do fairly well; but the soil is not well suited to alfalfa, oats, barley, and burley tobacco. Winter cover crops are needed both to protect the soil from washing and to supply humus and nitrogen when plowed under in spring. A short rotation of corn, wheat, and hay should be fairly well suited to the better drained part of the soil; but corn and hay can be grown in alternate years. All crops need fertilizer containing phosphorus and potash and all except legumes or legume-grass mixtures require nitrogen. Liming is necessary to insure success with legumes. Surface drainage can be improved by the use of small open ditches, but tile drains may not be of practical value because of high cost. Stream-bank protection with vegetation or engineering devices may be useful in preventing bank cutting and scouring of the soil by flood waters.

Philo stony fine sandy loam.—Occurring on imperfectly drained stream bottom lands, this soil is subject to annual overflow, chiefly in spring. Its parent material is derived from stony sandy alluvium washed from uplands underlain by acid sandstone. Native vegetation was a mixed forest of beech, maple, sycamore, elm, ash, and hemlock with an undergrowth of holly, mountain-laurel, and rhododendron. Both internal and surface drainage are slow, and slopes are less than 3 percent. The total area of 791 acres mapped is in the Cumberland Mountain section of the county in long strips along Tackett and Clear Fork Creeks and their branches. It is associated with Pope and Atkins soils in the bottom lands, with Jefferson soils on the adjacent colluvial lands, and with Muskingum soils on the nearby uplands.

Except for the stone content, the profile is essentially the same as that of the fine sandy loam. The surface 8 to 12 inches is grayish-brown to brownish-yellow stony fine sandy loam. Reaction is strongly to very strongly acid. Where cleared, it is relatively low in organic matter, but in forested areas the upper 2 or 3 inches are comparatively high in this constituent. As on the fine sandy loam, moisture conditions for plant growth are only fair because of the slow drainage. Tillage operations are definitely impeded by the angular sandstone fragments on the surface and in the soil.

The gray stony fine sandy loam subsoil is mottled with yellow and brown. It is about 2 feet thick and is underlain by stony and gravelly sandy stream alluvium. Sandstone bedrock is at a depth of many feet.

No significant variations are included other than local differences in the quantity of sandstone fragments on the surface and in the soil. On a few small areas where drainage is somewhat better than normal the gray layer is at greater depths.

Use and management.—The present use of Philo stony fine sandy loam varies from place to place. Most of the cleared part is in small part-time farms operated by coal miners. Approximately 25 percent of the soil is in forest, a part is idle or in volunteer pasture; and the rest is used for corn, lespedeza hay, and vegetables. Crops are not rotated; lime, fertilizer, and other soil amendments are not used; and no other practices for conserving or improving the soil are followed. Under present systems of management, acre yields of about 20 bushels of corn and less than $\frac{3}{4}$ ton of hay may be expected.

Although conditions for plant growth are only fair, requirements for good management are relatively simple. They are essentially the same as those of Philo fine sandy loam and are concerned chiefly with the proper selection and rotation of crops, the use of lime and fertilizer, and some simple practices for improving moisture conditions.

POPE SERIES

The soil of the Pope series is on well-drained bottom lands underlain by young stream alluvium that has washed largely from uplands underlain by sandstone and shale. It is very closely associated with the Philo and Atkins soils. Most of it is along the streams in the Cumberland Mountain section and along the rivers and larger creeks in the Great Valley section. All of it is on nearly level slopes, and none is sufficiently stony to interfere materially with tillage. Although this young soil does not have a well-developed profile, the surface layer is grayish-brown fine sandy loam, and the subsoil is yellow or brownish-yellow fine sandy loam. The underlying stream alluvium consists of beds of sand and gravel. Limestone, dolomite, shale, or sandstone bedrock is many feet below the surface. Only one type, the fine sandy loam, is mapped.

Pope fine sandy loam.—The parent material is derived from young stream alluvium washed largely from uplands underlain by sandstone and small quantities of shale and limestone. The soil is subject to overflow, chiefly in spring, but both surface and internal drainage are moderate. Slopes are less than 3 percent. Native vegetation was a forest of sycamore, beech, maple, red birch, sweetgum, hemlock, and willow.

Several large areas of the 607 acres are along Clear Fork Creek in the Cumberland Mountain section in association with Philo and Atkins soils in the bottom lands and Muskingum soils on the adjoining uplands. Long narrow strips are along the Powell and Clinch Rivers in the Great Valley section associated with Sequatchie soils on the adjoining terrace lands. Clarksville and Fullerton soils are on the nearby uplands. A few rather large areas are along some of the larger creeks that flow across Powell Valley, and various associated soils are of the uplands, colluvial lands, and terrace lands. A small acreage is in the shale valleys in the southeastern part of the county associated with Leadvale and Philo soils on the colluvial lands and bottom lands. Muskingum, Lehew, and Montevallo soils are on the adjoining uplands.

This young soil does not have a definitely developed profile. The surface 8 to 16 inches is friable grayish-brown fine sandy loam. It is medium to strongly acid in reaction and is relatively low in organic

matter but is higher than the soils of the surrounding uplands. In spring it is subject to overflow. Water circulates freely through the soil, however, and moisture conditions are generally favorable for plant growth, although crops on some of the lighter textured areas may be injured by droughts. Good tilth is easily maintained, and tillage can be accomplished over a wide range of moisture conditions.

The yellow or brownish-yellow friable subsoil is fine sandy loam, which is faintly mottled with gray and brown in the lower part. It is about 2 feet thick and is underlain by young stream alluvium consisting of beds of sand and gravel. Various kinds of bedrock are many feet below the surface.

Variations are chiefly in texture. The soil along the Powell and the Clinch Rivers is light in texture, being a loamy sand in many places; whereas areas in the shale valleys are chiefly silt loam. Where the streams flow through limestone areas, a small quantity of limestone material is in the soil, and locally thin layers of local alluvium from limestone material are over the surface of the original soil.

Use and management.—At present most of Pope fine sandy loam is used for purposes for which it is well suited physically, but management practices are not designed to compensate for soil deficiencies. All the soil is cleared and cultivated—it is used chiefly for growing corn, but some is in hay and vegetables. Corn is grown for many years in succession on much of the soil, but in some places several years of corn are interspersed at intervals with hay crops—chiefly lespedeza. Lime and fertilizers are not used for any crops. Under the prevailing systems of management acre yields of about 35 bushels of corn and $1\frac{1}{4}$ tons of lespedeza or mixed hay may be expected.

Requirements for good management are relatively simple and can be accomplished with ease. The soil is suited to all the crops commonly grown in the county with the possible exception of burley tobacco and deep-rooted legumes as alfalfa. Some of the larger broader areas can be used in a corn-small grain-hay rotation to advantage; but, where necessary, row crops can be grown each year without seriously depleting the soil if cover crops are seeded in fall and plowed under the following spring. These crops protect the soil from scouring by overflow waters and furnish nitrogen and increase humus. All crops need fertilizer containing nitrogen, phosphorus, and potassium except legumes, which ordinarily require no nitrogen. Lime is necessary for good stands of legumes; it neutralizes acidity and furnishes calcium. In places trees or close-growing vegetation should be planted along the stream banks to prevent bank cutting and to check the velocity of overflow water. On some of the small narrow strips along the Powell and Clinch Rivers, it may be impractical to use the soil for any other purpose than growing corn without special practices because of its inaccessibility and susceptibility to frequent overflow.

ROANE SERIES

The soil of the Roane series is on well-drained narrow bottom lands along the small streams in the cherty ridge sections. The parent material is derived from alluvium washed largely from uplands underlain by cherty dolomite. The soil is mapped on nearly level slopes. It is closely associated with the Greendale soils on the adjacent colluvial

lands and with various Clarksville and Fullerton soils on the nearby uplands. This young soil does not have a distinctly developed profile and is slightly to moderately cherty. The 6- to 10-inch brown silt loam surface soil is underlain by light-brown to yellowish-brown cherty silt loam or silty clay loam. A layer of compacted or cemented cherty material is at variable depths. The parent material of cherty alluvial material is several feet thick in most places and is underlain by cherty dolomite bedrock. One type, the silt loam, is mapped.

Roane silt loam.—This soil occurs on narrow bottom lands along small streams. Its parent material is derived from recent stream alluvium that has washed largely from uplands underlain by cherty dolomite. Surface drainage is moderate but internal drainage may be somewhat slow because of the cemented layer. Slopes are less than 3 percent. Native vegetation was a hardwood forest. The total area of 969 acres is in all the cherty ridge sections, but the largest proportionate acreage is in the south-central part along the small tributaries of the Powell River. It is in long narrow strips associated chiefly with Greendale soils on the adjacent colluvial lands and with various soils on the adjacent uplands underlain by cherty dolomite, chiefly of the Clarksville and Fullerton series.

This young soil does not have a distinctly developed profile, and the color and thickness of the various layers are variable. The surface 6 to 10 inches is friable brown silt loam. It is low to medium in organic-matter content but is generally higher than the associated soils of the uplands and colluvial lands. Reaction is medium acid to neutral. Moisture conditions are satisfactory for the growth of nearly all plants. Although the soil is subject to overflow, it ordinarily is covered with water at infrequent intervals for only a few hours at a time, for the surface drainage is sufficiently rapid to remove excess water in a short time. Some fine chert fragments are on the surface and in the soil in most places.

The 12- to 18-inch subsoil is light-brown to yellowish-brown friable moderately cherty silt loam to light silty clay loam. It is underlain by a 6- to 12-inch layer of compact or cemented fine chert particles and brown soil material mottled with gray, red, and yellow. This layer is underlain by several feet of cherty stream alluvium containing some lenses and layers of sand and fine gravel. Cherty dolomite bedrock underlies this alluvium.

As mapped, several variations are included. Soil along the smaller streams is not ordinarily subject to overflow. In places the subsoil layer may be missing, and the surface layer rests directly on the cemented layer. In a few places a large quantity of angular chert fragments is on the surface and in the soil. These variations are of small or moderate extent but are not confined to any definite locality but are in small areas wherever the soil is mapped.

Use and management.—The present use and management of Roane silt loam are variable, but, in general, they are fairly well adjusted to the physical properties of the soil. All the soil is cleared; about 40 percent is used for corn, 10 percent for burley tobacco, 25 percent for hay, and 25 percent for potatoes, vegetables, fruits, wheat, and a small acreage of pasture. Management systems vary. A few farmers use a rotation of a row crop followed by small grain seeded to

hay; much of the soil, however, is used continuously for growing row crops including corn, burley tobacco, and vegetables. Some farmers use fertilizer in moderate or large quantities, whereas others use none. A small part of the soil has been limed in recent years, but the quantities and frequency of application are not adjusted to the needs of the soil. No special practices for controlling water are used. Under prevailing systems of management, acre yields of about 28 bushels of corn, 10 bushels of wheat, 900 pounds of burley tobacco, and 1 ton of lespedeza or mixed hay are obtained.

Requirements for good management are concerned with the correct choice and rotation of crops and the use of lime, fertilizer, and other soil amendments. The soil is suited to intensive use; and corn, burley tobacco, vegetables, small grain, legumes with the possible exception of alfalfa, and various grasses do well. Under careful management row crops can be grown each year. After the crop is harvested in fall, a winter cover crop as winter oats or crimson clover can be used. This crop will protect the soil from washing in winter and will furnish nitrogen and increase the humus supply when plowed under in spring. Where practical from the standpoint of good farm management, a rotation of a row crop, small grain, and hay is well suited. An adequate lime supply is necessary for legumes, but tests should be made before the lime is applied, as part of the soil has enough lime and additional supplies will be wasted. All crops need moderate to large applications of phosphorus and some potash; but where legumes and winter cover crops are used, very little additional nitrogen is required.

Normal drainage is adequate, and erosion is not active except in some places where there is cutting and caving of stream banks. This can be partly controlled by the construction of check dams in the stream channels, especially the narrower intermittent ones, thereby slowing the rate of flow and lowering the cutting power of the water. Trees adjacent to the stream channel also are useful. Control of runoff on the adjacent upland slopes may be the most effective way of preventing erosion.

ROBERTSVILLE SERIES

The poorly drained soil of the Robertsville series is on level or slightly depressed terraces of small streams in limestone valleys. It is well above the level of present overflow and is very closely associated with the Taft soil. All of this soil is in Powell Valley. To a depth of 3 or 4 inches it is light-gray to almost white clay loam. The underlying layer is gray to bluish-gray silty clay mottled with brown and yellow. This material is heavier and more compact with increasing depth. Limestone bedrock is several feet below the surface. Only one type, the clay loam, is mapped.

Robertsville clay loam.—Small sized areas of the 107 acres mapped are in level or slightly depressed positions on low stream terraces in the limestone valleys, chiefly Powell Valley, in association with Taft soil. Lindside, Melvin, and Dunning soils are in the adjoining bottom lands. The parent material is derived from old alluvium that has washed largely from uplands underlain by limestone and some shale.

Native vegetation was a mixed forest of water-loving oak, maple, ash, elm, and willow. Both internal and surface drainage are slow.

The 3- or 4-inch surface soil is light-gray to almost white clay loam that is loose and floury when dry but sticky when wet. Where attempts to plow the soil have been made or where grazing has been heavy, this layer is puddled or cloddy. Organic-matter content is very low, and reaction is strongly or very strongly acid. Much of the year the soil is saturated with water, and in many places water stands on the surface for several days after heavy rains.

To a depth of 10 to 15 inches the heavy subsoil is sticky plastic gray silty clay mottled with brown, red, and yellow. It is underlain by a very heavy sticky tenacious bluish-gray silty clay containing some yellow and brown mottlings. Fine-textured alluvium chiefly from uplands underlain by limestone underlies this layer. Limestone bedrock is at a depth of several feet below the surface. No significant variations are included.

Use and management.—At present all of Robertsville clay loam is cleared and used for pasture. Pasture plants include chiefly wild grasses and sedges, cattails and sweetflag in some of the wettest spots, and in a few places lespedeza and redtop. Lime and fertilizer are not ordinarily used. The growth of vegetation is thick in most places, but the carrying capacity of the pastures is low because the plants are unpalatable and have low nutritive value for livestock.

The quality and yield of pastures can be greatly improved by good management. Alsike clover, bluegrass, white clover, redtop, and lespedeza do well if properly managed. Lime is required to neutralize soil acidity and furnish calcium, and phosphorus and possibly potash are needed in moderate quantities. Surface drainage can be improved by open ditches, but the cost of tile drainage would probably be greater than the benefit derived. Clipping pastures at intervals may be necessary to remove weeds.

ROLLING STONY LAND (TALBOTT SOIL MATERIAL)

Areas of Rolling stony land (Talbot soil material) are on rolling or strongly rolling valley uplands underlain chiefly by high-grade limestones of the Black River, the Stone River, and the Trenton formations. Slopes are 7 to 20 percent. In conformation the land surface is very irregular because of the large number of lime sinks. Surface drainage is moderate; and even though bedrock is at shallow depths, internal drainage is adequate because the rocks are folded and broken so that there are fissures permitting free water movement. Native vegetation was a mixed forest of oak, hickory, maple, some walnut, and redcedar.

This land type is in Powell and Cedar Fork Valleys and the valley of Little Sycamore Creek in broad areas associated with Smooth stony land (Talbot soil material) and soils of the Dewey and Talbot series. Ooltawah soil is in the bottoms of some of the larger lime sinks. Relatively small areas associated with Clarksville and Fullerton soils also are in the cherty ridge sections. The total area mapped is 13,971 acres.

From 25 to 75 percent of the surface is limestone bedrock outcrops. Between the outcrops is heavy soil material a few inches to 2 or 3 feet

thick. It has properties similar to those of the Talbott soils, is yellowish or reddish silty clay loam to silty clay, and is relatively low in organic matter. Simple chemical tests indicate that it is strongly or very strongly acid in reaction even though it is underlain at a shallow depth by limestone bedrock. Moisture conditions for plant growth are good during periods of adequate rainfall, but during droughts plants are injured by lack of moisture owing to the shallowness over bedrock and the consequent low moisture-holding capacity. In addition to the bedrock outcrops loose limestone fragments are over the land in many places.

In addition to the relatively wide range of slopes the chief variation is in the kind of underlying rock. Possibly a fourth of the land type is in the cherty ridge section where the outcrops are of cherty dolomite and the soil material resembles the Fullerton soils. Much of this variation has slopes near 20 percent, and moisture conditions and other factors are less favorable for plant growth than on the typical land of the limestone valleys.

Use of management.—The present use and management of Rolling stony land (Talbott soil material) vary from place to place, but most of it is cleared or is in thin, open, cut-over forest. Practically all of it is now used for pasture land, but management practices vary widely. A few farmers maintain high quality bluegrass and clover pastures by the use of lime and phosphate, eradication of weeds, and careful control of grazing. Most pastures, however, consist of a mixture of bluegrass, broomsedge, some clover, and various other wild and tame herbaceous plants. Amendments are not used, and no attempt is made to remove weeds and brush. The number of grazing animals is not adjusted to the varying carrying capacity of the pastures during different seasons. Under such systems of management, good quality pastures are obtained in spring and late in fall, but in summer they are generally poor.

Most of the land can be profitably used for pasture, although the steepest and stoniest parts are probably better suited to forest. Requirements for good pasture management will vary from farm to farm, depending upon the quantity of this land on the farm, the kinds and acreages of other soils, type of farm enterprise, and other factors. Applications of lime and phosphorus will increase the yield and quality of pasture and in general will be profitable. Where treated, the pasture mixtures consist largely of bluegrass and white clover; and under proper grazing few weeds will appear. Where weed eradication is necessary, it can be accomplished with a mowing machine in a few places where the outcrops do not protrude far above the surface; but where the outcrops are higher, hand mowing will prove profitable if low-cost labor is available. Even under good management the carrying capacity of pastures is greatly reduced in summer, and provision for temporary summer pasture elsewhere should be made for part of the livestock in order to prevent injuring the stands by overgrazing. Thin shading by widely spaced locusts or black walnuts is beneficial to pastures, but other trees and brush should be removed. Under some conditions intensive management may not be profitable, and it may be necessary to use the land in its natural condition without special management practices.

ROUGH GULLIED LAND (MONTEVALLO SOIL MATERIAL)

Very severely eroded Montevallo soils form the Rough gullied land (Montevallo soil material). In most places practically all the profile of the original shallow soil and parent material has been removed, and the gullies are now entrenched in the underlying soft fissile acid shale. Slopes range from 8 to more than 30 percent with most of the land having slopes in the upper part of the range. Small areas occur on the slopes of the shale knobs in the southeastern part of the county associated with Montevallo soils on the uplands and with Leadvale and Philo soils in the adjacent stream valleys. The total area mapped is only 391 acres.

Use and management.—At the present time practically all of Rough gullied land (Montevallo soil material) is abandoned. Much of it is devoid of any kind of vegetation, but in places there are thin stands of shortleaf or scrub pines and a scant growth of broomsedge. In most places active accelerated erosion continues, and the adjoining less severely eroded soils are gradually being reduced to the condition of this land. The productivity of soils on adjoining colluvial lands and bottom lands is being impaired by accumulation of materials from these lands.

Reclamation of this land type is even more difficult than that of the Rough gullied land (Talbott soil material) inasmuch as more of the original soil is gone and the remaining material is much less fertile. Soil and moisture conditions are so poor that only the more drought-resistant trees can be grown. Plantings of pine offer the best means of stabilizing the land, although check dams may be necessary in the larger more active gullies. After forests become established, they should be maintained by good forest management.

ROUGH GULLIED LAND (TALBOTT SOIL MATERIAL)

Rough gullied land (Talbott soil material) consists chiefly of Talbott and Fullerton soils that have been very severely eroded so that the present land surfaces are largely a network of gullies. The underlying soil material is chiefly cherty red or yellowish-red silty clay loam or silty clay. Slopes range from 8 to more than 30 percent with about two-thirds of the land having slopes in the upper part of the range. An aggregate area of 326 acres is mapped. Small areas are throughout the cherty ridge section in association with Clarksville and Fullerton soils. Areas also are in the limestone valleys associated with Talbott and Dewey soils.

Use of management.—Practically all Rough gullied land (Talbott soil material) is abandoned. A few areas have been reforested through the efforts of public agencies, but much is covered with sparse growths of wild grasses and with small volunteer trees, including scrub pine, persimmon, and various oak. Part of it is devoid of vegetation of any kind. This land is of very little value to its owners; in fact, in its present condition it is a liability, inasmuch as the present vegetation in places is not effective in checking active erosion and adjacent uneroded uplands will be encroached upon by headward cutting of gullies. Nearby colluvial and bottom lands will have their productivity reduced by the accumulations of heavy infertile subsoil materials deposited over them.

Reclamation of this land can be accomplished by the individual farmer only by very slow processes over an extended period of time. The specific practices needed will vary from farm to farm and from place to place. In many places it will be necessary to stabilize the larger gullies by the use of check dams. Forest trees, principally pine and black locust, are probably the best vegetation to use for controlling erosion when cost and effectiveness are considered. Better stands and more vigorous growth can be obtained if small or moderate quantities of phosphorus are applied at the time that the trees are planted. Much of this land is best used if allowed to remain in forest permanently after it is once established. *Sericea lespedeza* and kudzu, however, are herbaceous plants that may be effective in reclaiming some of the more level areas. After these plants have become well established, they will furnish some pasture to livestock, but grazing must be very carefully controlled to prevent injury to the stand of cover plants.

ROUGH STONY LAND (MUSKINGUM SOIL MATERIAL)

Characterized by numerous sandstone outcrops on about half the area, Rough stony land (Muskingum soil material) is suited only to forestry. It is on steep mountain slopes, bluffs, and escarpments underlain by massive sandstones and conglomerates. Slopes range from 30 to 60 percent, with much of the land having slopes in the upper part of the range. Surface runoff is very rapid and internal drainage, rapid. Moisture conditions and other factors that affect plant growth are unfavorable. Native vegetation included shortleaf and Virginia scrub pines, post, blackjack, and chestnut oaks, blackgum, and dogwood.

This land type differs from Limestone rockland (rough) chiefly in that the underlying rocks are sandstone rather than dolomite and limestone. In general the outcrops are larger and protrude farther above the land surface. The small quantities of soil material are similar to the Muskingum soils rather than the Fullerton and Clarksville soils.

Most of this land is in very large areas of several hundred acres along the face of the Cumberland Mountain escarpment and on its opposite slope along Tackett and Little Yellow Creeks. Other smaller areas are throughout the Cumberland Mountain section. It is associated with Muskingum soils on the mountain slopes and with Jefferson and Philo soils in the creek valleys. It also is on the crests of Powell Mountain in the extreme east-central part of the county associated with Muskingum, Lehew, and Armuchee soils. The aggregate area is 13,881 acres.

Use and management.—All the land is now in forest in the Cumberland Mountain section, where it is owned by one corporation. Forest management practices are similar to those for Muskingum stony fine sandy loam. In general all the merchantable timber has been cut, and present stands are chiefly immature, cull, or stunted trees. The rate of tree growth is slow because of unfavorable moisture and soil conditions, and the yields and quality of timber are relatively poor. The land is totally unsuited to any other use, however, and can be best used for forest.

ROUGH STONY LAND (TALBOTT SOIL MATERIAL)

Frequent limestone outcrops occur on 25 to 75 percent of the surface of Rough stony land (Talbott soil material). It is chiefly on steep slopes and bluffs underlain by cherty dolomite of the Copper Ridge and Beekmantown formations along the larger streams of the county, but it also is on similar slopes underlain by high-grade limestone chiefly of the Trenton formation on the lower slopes of valley mountains. The original forest cover consisted of oak, hickory, blackgum, sourwood, some beech and maple, and pine and cedar in the more droughty sites. Slopes range from 30 to 60 percent, but are usually 45 percent or more. Surface drainage is very rapid, and internal drainage is moderate.

An aggregate area of 14,723 acres is mapped, chiefly in the cherty ridge sections in large areas on the steep slopes along the Powell and Clinch Rivers and their tributaries. Irregularly shaped areas of small or medium size are on the lower northwest-facing slopes of Powell and Lone Mountains and Wallen Ridge and on the southeast-facing slopes of Poor Valley Ridge. Small areas are on the short steep slopes along the streams in the limestone valleys.

Although the chief difference between this land type and Rolling stony land (Talbott soil material) is in slope, it also differs in other characteristics. Most of the outcrops protrude a foot or more above the ground. Over much of the area the underlying rocks are cherty dolomite, and the soil material in the intervening spaces more nearly resembles the Fullerton than the Talbott soils. In most places it is reddish cherty silty clay or silty clay loam that ranges in thickness from a few inches to several feet. It is strongly or very strongly acid in reaction, low in organic matter, and relatively low in plant nutrients. Moisture conditions are poor because of the large runoff and the shallow depth of soil material.

Use and management.—The use and management of Rough stony land (Talbott soil material) vary from place to place. Most of the land on the mountain slopes is used for pasture land, whereas the part in the cherty ridge section is almost entirely in forest. In general, no special management practices are used on pastures; and they consist of volunteer wild and tame plants including much broomsedge and some lespedeza, bluegrass, and white clover. These pastures furnish a moderate quantity of fair grazing in spring and late in fall, but they are dry and of very poor quality in summer.

The use suitability varies somewhat from one part of the county to another, and consequently the management requirements also are variable. Much of the land on the mountain slopes can be used for pasture; although its use on any individual farm may be determined by the acreage and distribution on the farm, the proportion and kinds of other soils, and many other factors as well as the physical use suitability of the land itself. Management requirements likewise will vary; in some places it may be advisable to use very few or no special practices, whereas in others the more intensive practices for Rolling stony land (Talbott soil material) are applicable. Practically all the land in the cherty ridge section has so many unfavorable properties that it is not physically suited to growing either crops or pasture but is best used for forest.

SEQUATCHIE SERIES

The Sequatchie soils are on low terraces along the rivers and larger streams. Their parent material is old stream alluvium washed chiefly from uplands underlain by acid sandstone. They are chiefly along the Powell and Clinch Rivers, but some rather broad areas are along the larger streams in Powell Valley. The soil is practically stone-free, and none is seriously eroded. About two-thirds of it is nearly level, and the rest is sloping.

The surface layer of these soils is light-brown or grayish-brown fine sandy loam underlain by a yellowish-brown subsoil somewhat heavier in texture. The parent material of sandy alluvium has washed from uplands underlain by sandstone and small quantities of shale and limestone material. Lenses and layers of gravel are common.

Agriculturally, these are relatively important soils, for most of them are at least moderately productive and are suited to growing a wide variety of crops. Many areas are in sections where the proportion of soils suited to cropland is small. Management requirements are concerned chiefly with proper selection and rotation of crops and the correct use of lime and fertilizer. One type and one phase, the fine sandy loam and its sloping phase, are mapped.

Sequatchie fine sandy loam.—An aggregate area of 1,302 acres is mapped on low terraces along the rivers and larger streams of the county. The parent material is alluvium that has washed largely from uplands underlain by sandstone and some shale and limestone materials. Slopes are less than 1 to 7 percent but are predominantly nearly level. Both surface and internal drainage are moderate. Native vegetation was a hardwood forest.

Relatively broad areas of soil are along the small streams that flow across Powell Valley. It is associated in a complex pattern with soils of the colluvial lands, bottom lands, and uplands, including those of the Jefferson, Allen, Caylor, Lindside, Melvin, Philo, Atkins, Dewey, and Talbott series. Long narrow strips are along the Powell and Clinch Rivers and Indian Creek in association with the sloping phase on the terrace lands and the Pope soil on the bottom lands. Various Clarksville, Fullerton, and Bolton soils and Rough stony land (Talbott soil material) are on the adjoining uplands.

To a depth of 12 to 18 inches the surface soil is light-brown or grayish-brown friable fine sandy loam. It is medium to strongly acid and relatively low in organic matter. Good tilth is easily maintained, and tillage can be carried on over a fairly wide range of moisture conditions. Plant roots penetrate the soil readily, and air and moisture circulate freely. Moisture-holding properties are relatively poor, but the moisture supply for crops is generally adequate because of the gentle slopes.

The 12- to 14-inch subsoil is yellowish-brown, light-brown, or reddish-brown clayey sand to sandy clay. It is underlain by dominantly yellow or brown sandy alluvium that may be mottled in some places with yellow, gray, and brown. Beds of gravel and sandstone fragments are present. Limestone or cherty dolomite bedrock is at a depth of many feet.

Several variations are mapped. The part along the small streams in Powell Valley is somewhat heavier in texture, more brown in color,

and more distinctly developed in profile. Another variation of small extent in Powell Valley includes areas in which the lower part of the subsoil is slightly compact or lightly cemented. Small areas may have a considerable quantity of angular sandstone fragments on the surface and in the upper part of the soil. In some places chert that has rolled from the adjoining slopes is on the surface. None of these variations is of sufficient extent to significantly alter the use suitability or management requirements.

Use and management.—The present use of Sequatchie fine sandy loam is fairly well adjusted to its physical properties, but increased crop yields can be obtained by improved management. All the soil is cleared and cultivated, chiefly to corn, wheat, burley tobacco, and hay. In Powell Valley part of it is used for pasture. Systematic rotation of crops is not generally practiced; row crops and small grains are grown for several years followed by a few years of hay. Tobacco receives moderate to large applications of complete fertilizer, and small quantities are applied to corn and small grains. Hay crops are not ordinarily fertilized, and very little of the soil is ever limed. Special practices for conserving moisture are not used. Under prevailing systems of management, acre yields of about 30 bushels of corn, 15 bushels of wheat, 1,100 pounds of burley tobacco, and 1¼ tons of lespedeza or mixed hay may be expected. Where lime is used in addition to other common practices, about 2 tons of alfalfa an acre may be obtained.

Requirements for good management are relatively simple and can be easily accomplished. They are concerned chiefly with the proper selection and rotation of crops and the use of lime and fertilizer. The soil is suited to growing a wide variety of crops, including corn, burley tobacco, small grains, grass and legume hays, vegetables, and fruits. It can be conserved under short rotations including a row crop once in 2 or 3 years; a rotation of a row crop followed by a small grain seeded to an annual legume is well suited. Where it is practical to use longer rotations, alfalfa may be included. In any case, cover crops—either grasses or legumes—should be maintained in fall and winter, for they prevent soil erosion and when plowed under in spring increase humus and nitrogen supplies.

Tobacco and vegetable crops need moderate to large quantities of complete fertilizer that is high in phosphorus and potash and medium in nitrogen. Small grains require similar fertilizer in smaller quantities with a smaller proportion of potash. Legumes, either alone or in grass mixtures, need phosphorus, probably potash, but no nitrogen. Grasses grown alone should receive a complete fertilizer. Lime is required to obtain good stands of legumes. Where crops are rotated and adequately fertilized, no special practices for controlling runoff are necessary.

Sequatchie fine sandy loam, sloping phase.—This phase is on sloping to strongly sloping parts of low river terraces. Slopes range from 7 to 20 percent, but are mostly greater than 15 percent. The parent material is derived from stream alluvium washed from uplands underlain by sandstone and small quantities of limestone and shale materials. Internal drainage is moderate and surface drainage, somewhat rapid. Native vegetation was a hardwood forest.

The total area mapped is 625 acres. Most of the soil is along the Powell and Clinch Rivers in long narrow strips on short strong slopes that lie between the normal phase on the higher nearly level terrace benches and Pope fine sandy loam on the adjoining narrow level bottom lands. Fullerton, Clarksville, and Bolton soils and Rough stony land (Talbot soil material) are on the adjoining upland slope. A small acreage is on the more sloping parts of the terraces along the streams of Powell Valley associated in a complex pattern with other soils of the terrace lands, colluvial lands, bottom lands, and uplands.

The surface 10 to 15 inches is grayish-brown or light-brown friable fine sandy loam that is medium to strongly acid in reaction and relatively low in organic-matter content. Good tilth is easily maintained, but tillage operations are more difficult than on the normal phase because of the stronger slopes. The soil is permeable to moisture and plant roots. The relatively low moisture-holding capacity may result in crop injury during droughts, but ordinarily the moisture supply is adequate in normal seasons.

The 10- to 20-inch subsoil is yellowish-brown to brownish-yellow fine sandy loam to light sandy clay that is underlain by sandy stream alluvium and beds of sandstone and quartz gravel. This alluvium is several to many feet thick and is generally underlain by cherty dolomite. No significant variations other than those in color and texture are mapped.

Use and management.—The use and management of Sequatchie fine sandy loam, sloping phase, vary from place to place, but in general they are not well adjusted to the physical properties of the soil. Most of the soil is cleared, but some of the steeper parts are in woodland. Cleared areas are used almost exclusively for corn and hay, chiefly lespedeza. Small quantities of fertilizer are used on corn, but none is ordinarily applied to hay crops. None of the soil is limed, and no practices for conserving moisture or preventing erosion are ordinarily used. Under prevailing systems of management, acre yields of about 20 to 25 bushels of corn and $\frac{3}{4}$ to 1 ton of hay may be expected.

Although this soil is similar to the normal phase in most physical properties, its management requirements are more exacting and its use suitability is much more limited because of the stronger slopes. Much of the soil on narrow strong slopes should remain in close-growing crops most of the time in order to prevent stream scouring and damage to the normal phase on the higher, more level part of the terrace. Various grasses and legumes are suited, but they require small to moderate quantities of fertilizer and lime. Some of the wider less strongly sloping areas can be used in rotations similar to those used on the normal phase, but the hay crop should remain for a longer time. On these areas the soil is suited to crops similar to those on the normal phase, and similar fertilization and other management practices are required.

SEQUOIA SERIES

The soil of the Sequoia series is on rolling slopes in valleys underlain by interbedded limestone and shale. It is chiefly in one small valley in the southern part of the county. Native vegetation was a mixed hardwood forest. The soil is associated with Armuchee and Dewey soils and the miscellaneous land types of Talbot soil material.

It is relatively unimportant because of the small total area, 195 acres.

The grayish-brown silty clay loam surface layer is underlain by a brownish-yellow heavy subsoil. Shale bedrock containing thin lenses of limestone is at shallow depths. This acid soil is low in organic matter and relatively low in fertility. It is moderately eroded and erodes easily where cleared. The eroded phase of the silty clay loam is mapped.

Sequoia silty clay loam, eroded phase.—This upland soil is in low lying valleys underlain by interbedded shale and limestone probably of the Conasauga formation (14). It was developed under a mixed hardwood forest of oak, hickory, beech, and maple; although shortleaf pine was possibly in some places. Slopes are 8 to 15 percent. Surface drainage is moderate, but internal drainage may be retarded slightly by the heavy subsoil.

Most of the soil is on the uplands along Straight Creek in the southern part of the county. It is in small-sized areas associated chiefly with Armuchee soils; but the soil pattern is very complex because of folding and faulting of the underlying rocks, and soils of the Dewey, Montevallo, and Fullerton series and miscellaneous land types of Talbott soil material are on the immediately adjacent uplands. A few small areas in Powell Valley are chiefly on foot slopes associated with Armuchee soils.

The profile is similar to that of Talbott silty clay loam, eroded phase, but it has a lighter-colored surface soil and subsoil and is not so heavy and compact in the subsoil. The surface 6 inches is moderately friable grayish-brown silty clay loam with a fine crumb structure. It is low in organic matter and strongly acid in reaction. Air, moisture, and plant roots penetrate the soil easily. Tillage can be accomplished without injury to tilth only within a relatively narrow range of moisture conditions. Where the soil is severely eroded, much of the original surface soil is missing, and the present surface layer is largely the upper subsoil mixed with the small quantity of remaining original surface soil. In these places, moisture conditions are less favorable, and good tilth is maintained with difficulty.

The subsoil is brownish-yellow sticky plastic silty clay loam with a well-developed nut structure. At a depth of about 12 inches it grades into light brownish-yellow sticky plastic silty clay mottled with gray, red, and light yellow. This breaks into coarse nutlike aggregates. The underlying rock is yellow or greenish-yellow shale containing thin beds and lenses of gray or blue shaly limestone. In most places this rock is at depths of 3 to 4 feet; but where the soil is severely eroded, thin ledges of limestone may outcrop on the surface.

The chief variations are due to differences in erosion. As the soil is associated in a complex pattern with other limestone and shale soils in some places, small areas of Montevallo and Dewey soils and miscellaneous land types of Talbott soil material may be included.

Use and management.—Sequoia silty clay loam, eroded phase, is used for purposes for which it is at least fairly well suited, but management practices are not designed to compensate for soil deficiencies. Practically all the soil is cleared and cultivated to corn, burley tobacco, vegetable, and hay. General management practices are similar to those used on Talbott silty clay loam, eroded phase. Under common

management practices, acre yields of about 20 bushels of corn, 750 pounds of burley tobacco, and $\frac{3}{4}$ ton of lespedeza hay may be expected.

Requirements for good management include increasing the humus and nitrogen supplies; supplying lime, phosphorus, and possibly potash; conserving soil moisture; preventing erosion; and maintaining or improving tilth conditions. The requirements are similar to those for Talbott silty clay loam, eroded phase.

SMOOTH STONY LAND (TALBOTT SOIL MATERIAL)

Smooth stony land (Talbott soil material) consists of alternate strips of limestone bedrock and heavy limestone soil material on level to gently sloping uplands in limestone valleys. It is underlain by relatively high-grade limestone of the Stone River and Black River formations. The original vegetation was a hardwood forest of oak, hickory, maple, some walnut, and redcedar. Slopes range from 0 to 7 percent. Surface drainage is moderate, but internal drainage may be somewhat slow because of the shallow depth to bedrock and the heavy soil material. The aggregate area is only 641 acres. Broad areas are chiefly in Powell and Cedar Fork Valleys, and small areas are in the valley of Little Sycamore Creek. It is associated chiefly with Rolling stony land (Talbott soil material) and Talbott and Dewey soils.

Limestone outcrops are on 25 to 75 percent of the area and protrude above the surface only a very few inches in most places. The soil materials range from a few inches to 2 or 3 feet thick. They are chiefly silty clays and have properties similar to those of the subsoils of the Talbott soils. They are generally acid in reaction and relatively low in organic matter and in mineral plant nutrients. Moisture conditions are favorable for the growth of grasses except during periods of low rainfall when the supplies in the shallow soil materials become depleted.

Use and management.—Most of the Smooth stony land (Talbott soil material) is cleared and used almost entirely for pasture, although a small acreage is in hay and corn. Pastures consist almost entirely of volunteer or wild grasses including bluegrass, white clover, lespedeza, and broomsedge. Few special practices for improving pastures are used, but most farmers make some attempt to keep down brush and weeds. Corn yields are very low, but under current management the land is fairly productive of pasture.

Because of the large number of bedrock outcrops and the shallow soil this land is poorly suited to growing crops, but under good management it is good grazing land. Management requirements are concerned with selecting proper pasture mixtures and providing proper amendments for them. Bluegrass and white clover are well suited, and lespedeza, other clovers, and grasses do well. Small or moderate applications of phosphate and lime will increase both the quantity and quality of grazing. Weeds and brush can be controlled by clipping with a mower if the outcrops do not protrude far enough above the surface to interfere with mowing. Grazing should be carefully controlled during dry periods to prevent injury to the pasture stand. Thin shading by widely spaced locust or walnut trees is beneficial.

STONY COLLUVIUM (MUSKINGUM SOIL MATERIAL)

Stony colluvium (Muskingum soil material) is an accumulation of sandstone and conglomerate cobbles and boulders at the foot of mountain slopes and in the channels of streams on Cumberland Mountain. In a few places some sandy soil material may be in the spaces among the rocks, but in general there is little of this material. The physical properties of the material are very unfavorable for plant growth, but moisture seeps from the surrounding hillsides and hemlock, beech, and maple do well. The part of the land along the stream channels is devoid of vegetation or has small willows on it. Slopes are nearly level to strongly rolling. Small areas, totaling 494 acres, are throughout the Cumberland Mountain section associated with Muskingum soils on the uplands and Jefferson and Philo soils in the stream valleys.

Use and management.—This is a very infertile soil with so many other unfavorable properties that the better part of it is suited only to forest use, whereas the poorer part is wasteland and has no value for growing plants. Forestry practices similar to those used on the adjoining uplands are applicable.

TAFT SERIES

The strongly acid soil of the Taft series is on nearly level imperfectly drained low terraces along small streams in the limestone valleys. It is in Powell Valley generally above the level of present overflow. Although similar to the Monongahela soil, its parent material differs in being derived chiefly from old limestone alluvium rather than sandstone and shale and its texture is somewhat heavier. None of the soil is eroded to any extent.

The surface soil is a loose floury light-gray silt loam. The upper subsoil is grayish-yellow clay loam or silty clay loam, and the lower subsoil is bright-yellow compact silty clay loam. At depths of 30 to 40 inches a mottled gray and yellow compact layer is present. It is underlain by heavy gray silty clay old stream alluvium derived from limestone material. Limestone residuum or bedrock is several feet below the surface. Only one type, the silt loam, is mapped.

Taft silt loam.—This soil is mapped in limestone valleys on low, imperfectly drained, nearly level terrace benches along small streams above present overflow. Parent material is derived from old stream alluvium washed largely from uplands underlain by limestone, some shale, and a small quantity of sandstone. Native vegetation was a hardwood forest of water-loving oak, maple, sweetgum, blackgum, and willow. Slopes range from 0 to 7 percent, but nearly all the soil has slopes of 2 to 3 percent. Both surface and internal drainage are slow.

The total area of 779 acres is in Powell Valley, chiefly in a few broad areas of large extent. Robertsville clay loam is the principal associated soil on the terraces. Lindside and Melvin soils are on the adjacent bottom lands; Allen and Caylor are on the surrounding colluvial lands; and Dewey and Talbott and Rolling and Smooth stony lands (Talbott soil material) are on the adjoining uplands.

The profile is similar to that of Monongahela silt loam, but it is generally heavier in texture and slightly more fertile because of the

limestone material that has contributed to its formation. The surface 8 inches is loose floury light-gray silt loam. The soil is strongly or very strongly acid and is low in organic matter. During heavy or prolonged periods of rain it becomes saturated with water because of the impermeability of the underlying layers and remains cold and wet in spring so that planting of crops is delayed. If plowed when too wet it puddles or becomes cloddy, and subsequent tillage operations are accomplished with difficulty.

The 6- to 10-inch upper subsoil is grayish-yellow clay loam or silty clay loam that is friable when moist but somewhat hard and brittle when dry. It grades into a bright-yellow silty clay loam with a distinct nut structure, the lower part of which is somewhat compact and contains some faint-gray mottlings. This is 10 to 15 inches thick and grades into yellow compact silty clay heavily mottled with gray and brown; this layer breaks into large angular lumps. It is underlain by heavy gray silty clay alluvium washed largely from uplands underlain by limestone. Limestone residuum or bedrock is several feet below the surface.

Several variations are included. In a few places the parent material is washed almost entirely from uplands underlain by cherty dolomite. The alluvium is thin in some places, and limestone bedrock may be at depths of 3 to 4 feet. In a few places the surface soil is grayish brown, but otherwise the profile is essentially the same as that of the normal type.

Use and management.—The present use and management of Taft silt loam are not well adjusted to its physical properties. Practically all of it is cleared; a small part is used for corn and small grains, but most of it is in hay and pasture. A common practice is to grow corn for 1 or 2 years and then sow lespedeza mixed with some grasses as timothy and redtop. These crops are cut for hay or used for pasture for several years until they become too weedy to be useful; then the soil is again plowed for corn. Small quantities of fertilizer are used on small grains and corn, but none is ordinarily applied to hay or pasture. Very little of the soil is ever limed. A few farmers attempt to improve surface drainage by constructing shallow open ditches, but this practice is not common and tile drains are not used. Under the prevailing systems of management acre yields of about 18 bushels of corn, 11 bushels of wheat, and $\frac{1}{2}$ ton of lespedeza may be expected.

The use suitability is somewhat limited by imperfect drainage, but good management can be achieved with ease because of level slopes and the uneroded condition. The chief management requirements are concerned with supplying lime and fertilizer to suitable crops and improving soil moisture conditions. The soil is physically suited to short rotations, but in many places it can possibly be used to better advantage on long rotations because of the limited variety of crops that can be grown. Corn, soybeans, wheat, lespedeza, alsike clover, white clover and redtop are among the suitable crops; barley, oats, alfalfa, and possibly crimson clover are not well suited.

Legumes and grasses either alone or in mixtures increase the humus and nitrogen contents and better tilth conditions, but they require potash, phosphorus, and lime. Grasses without legumes need nitrogen also. Corn and wheat need a complete fertilizer containing small to medium quantities of nitrogen and potash and large quantities of

phosphorus. Barnyard manure is a valuable source of nitrogen and potash, and it improves tilth and moisture conditions; but it should be supplemented with phosphate fertilizer to obtain the proper balance of plant nutrients. On the more level areas, surface drainage can be improved by constructing small open ditches, but tile drains are not ordinarily practical.

TALBOTT SERIES

Soils of the Talbott series are in the limestone valleys closely associated with the Dewey soils. They differ from them, however, in being somewhat lighter in color; lower in organic matter, lime, and mineral plant nutrients; much tougher and more compact in the subsoil and substratum; and shallower over bedrock. Relief ranges from undulating to steep—11 percent of the soil is undulating; 53 percent, rolling; 31 percent, hilly; and 5 percent, steep. About 46 percent has a silt loam surface layer, whereas the rest has silty clay loam. All these soils are eroded to some extent, and more than three-fourths of them have had their productivity reduced by erosion (pl. 12).

The surface soil is grayish-brown moderately friable silt loam with a fine crumb structure. Where uneroded it is 6 to 8 inches thick, but in eroded areas it may be partly or entirely missing. The subsoil is tough compact sticky plastic silty clay about 2 feet thick. The heavy substratum also is sticky and plastic silty clay but is less tough and compact. It is reddish yellow mottled with gray, yellow, and rust brown. Slightly clayey limestone bedrock is at a depth of 4 or 5 feet.

Areas on undulating and rolling slopes are physically suited to the common field crops, but the hilly and steep phases are probably best suited to pasture. Requirements for good management are exacting. Careful practices, including engineering devices, for control of runoff are required, and efforts toward improvement of tilth conditions and moisture relations are necessary. The nitrogen and humus contents need to be increased, and lime, phosphorus, and potash are needed in soil amendments. One type and three phases—the silt loam with its hilly and steep phases and the eroded phase of the silty clay loam—are mapped.

Talbott silt loam.—A total area of 629 acres of this soil is mapped in the limestone valleys on slopes of less than 7 percent. The parent material was weathered from slightly clayey limestone of the Stone River and Black River formations (9). Native vegetation was a hardwood forest, chiefly of oak, hickory, and maple. Surface drainage is moderate, but internal drainage may be somewhat slow because of the compact subsoil. Most of the soil is in Powell Valley in medium-sized areas, but a few small areas are in Cedar Fork Valley and the valley of Little Sycamore Creek. It is associated chiefly with Talbott silty clay loam, eroded phase, and miscellaneous land types of Talbott soil material, but in some places it is associated with Dewey and Caylor soils.

The profile is similar to that of Talbott silty clay loam, eroded phase, but the surface layer is thicker and lighter in texture. The surface 6 to 8 inches is grayish-brown moderately friable heavy silt loam with a fine crumb structure. Reaction is generally strongly acid. Although the original supply of humus was not large, it has been depleted

by cropping and loss through erosion. In general, good tilth is maintained without difficulty, but the more seriously eroded areas furnish special problems. Moisture conditions are favorable for crops except during droughts or extended rains. A few small fragments of limestone rock are on the surface in some places.

The subsoil is reddish-yellow or yellowish-red sticky plastic tenacious heavy silty clay with a coarse nut or lumpy structure. Some fine chert fragments are present, and small black concretions are in the lower part. At a depth of about 2 feet this grades into reddish-yellow silty clay mottled with gray, brown, ocher, and yellow. This substratum has a nut structure and is less compact than the subsoil layer above. Clayey limestone bedrock is at an average depth of about 5 feet, but the rock floor is jagged and uneven.

Variations are due chiefly to differences in the degree of erosion. A few areas have lost a fairly large part of the original surface soil, and the present plow layer includes part of the upper subsoil. In these eroded places the problems relative to maintenance of good tilth and favorable moisture conditions and the control of erosion are essentially the same as for Talbott silty clay loam, eroded phase.

Use and management.—Many areas of Talbott silt loam are used and managed in the same manner as Talbott silty clay loam, eroded phase, but in general these practices are not well adjusted to the physical suitability of the soil. Practically all the soil is cleared and cultivated; about 35 percent is used for corn, 25 percent for small grain, 10 percent for tobacco and vegetables, and 30 percent for hay and pasture.

Systematic crop rotations are not generally followed; the kind of crop grown and the length of time that it remains in a given field are determined by the immediate needs of the farm operator. Corn and small grains ordinarily receive small applications of 0-10-4 fertilizer or superphosphate. Tobacco is fertilized with barnyard manure if it is available, and in many places it also receives heavy applications of commercial fertilizer. Hay and pastures receive small quantities of fertilizer. Very little of the soil is limed at regular intervals. Special practices for the control of runoff and erosion are not ordinarily used. Under present common management practices, acre yields of 25 bushels of corn, 15 bushels of wheat, 1 ton of lespedeza, and 600 pounds of burley tobacco may be expected. Where lime is used in addition to the common practices, about 1½ tons of red clover and 3¼ tons of alfalfa are average yields.

Management requirements are not so exacting as for Talbott silty clay loam, eroded phase; but practices for improving tilth and moisture conditions, preventing erosion, and increasing the supplies of humus, lime, phosphorus, and potash are required. Under a rotation including a row crop once in 3 to 4 years the soil can be conserved if other management requirements are met. Corn, burley tobacco, small grains, and some vegetable crops are fairly well suited. When properly treated alfalfa and red clover do well; they increase the organic-matter and humus contents, improve tilth of the surface soil, and prevent erosion.

Lime is necessary to obtain good stands of legumes. Barnyard manure is effective in increasing the nitrogen and humus contents, furnishing some potash, and aiding runoff control by improving tilth

and increasing the absorptive qualities of the soil. Liberal applications of phosphorus are required for all crops—including pasture—and potash also is needed. These materials are probably most economically furnished through high-analysis commercial fertilizer.

In general, runoff and soil moisture can best be controlled and conserved by proper choice and rotation of crops and proper use of amendments rather than by mechanical means. Cultivation, however, should be on the contour; and although broad-base terraces may be beneficial in some places, they must be very carefully planned, constructed, and maintained to be effective.

Talbott silt loam, hilly phase.—This soil occurs on the lower scarp slopes of the valley mountains. It is underlain by high-grade limestone of the Trenton formation (9). Slopes range from 15 to 30 percent, but are mostly about 25 percent. Surface drainage is rapid, but internal drainage may be somewhat slow because of the heavy subsoil. Native vegetation consisted chiefly of oak, hickory, maple, beech, and black walnut. A total of 1,825 acres is mapped. Areas are on the lower slopes and benches on the northwest-facing slopes of Powell and Lone Mountains and Wallen Ridge and on the southeast-facing slope of Poor Valley Ridge. It is in irregularly shaped areas in association with Talbott silt loam, steep phase; Talbott-Hayter silt loams; Armuchee soils; and miscellaneous land types of Talbott soil material.

The soil profile is similar to that of the normal phase, but more of the original surface layer has been lost because of greater erosion on the steeper slopes. The surface 4 to 6 inches is a grayish-brown moderately friable heavy silt loam with a fine crumb structure. It is strongly acid in reaction where it has not received applications of lime, but recently limed areas are only slightly acid. The organic-matter content is relatively low. Good tilth is moderately difficult to maintain, and soil moisture is conserved with difficulty, especially where tilled crops are grown. Small slabs of limestone rock are on the surface in some places.

The yellowish-red subsoil is sticky plastic compact heavy silty clay with a coarse nut or lumpy structure. It is about 24 inches thick and is underlain by yellowish-red silty clay mottled with gray, brown, red, and ocher. This substratum is less compact than the subsoil and has a more distinctly developed nut structure. Limestone bedrock is at an average depth of 4 feet, but the rock floor is jagged and uneven and bedrock outcrops are in some places.

Variations are due to differences in the degree of erosion and to the admixture of some sandy colluvial material. In some places where the soil has been used extensively for growing tilled crops, the original surface layer is entirely missing and the present surface soil is formed by the upper part of the original subsoil. In these places the surface is sticky and plastic when wet and hard and intractable when dry. Similar conditions exist in many very small areas where pastures have been overgrazed. Much of this phase is immediately adjacent to areas of Talbott-Hayter silt loams and the boundaries between the soils are not distinct. Sandstone rock fragments may be on the surface and sandy soil material may be mixed in the surface layer in many places along the edges of the areas mapped.

Use and management.—The present use and management of Talbott silt loam, hilly phase, are fairly well adjusted to the physical suitability of the soil; but in some places improper use and poor management are practiced. Practically all the soil has been cleared and used for growing tilled crops and pasture, but about 20 percent has been abandoned and is now second-growth forest. At present about 40 percent is used for permanent pasture; 25 percent for hay crops; and 15 percent for other crops, including corn, tobacco, vegetables, and small grains.

Where used for tilled crops, a systematic crop rotation is not commonly practiced and the kind of crop grown is determined largely by the immediate needs of the farm operator. Grazing is not carefully controlled on pastures during periods of adverse moisture conditions, and only a few farmers remove weeds by mowing. About half the pastures receive applications of lime and superphosphate at fairly regular intervals, and the rest ordinarily receive no amendments. Hay crops are not generally fertilized, but most farmers use a small quantity of commercial fertilizer on corn, tobacco, and small grains. Terracing, strip cropping, and control of gullies are not commonly practiced; but where the soil is cultivated, tillage is roughly on the contour. Under common management practices, acre yields of about 10 bushels of corn and 1 ton of hay are obtained. Yields of tobacco, small grain, and vegetables are very small, and about 40 cow-acre-days of grazing may be expected.

Uses of this phase are very limited, and management requirements are exacting because of the difficulty of working and conserving the soil. Tilled crops are poorly suited, and the soil is best used for permanent pasture if feasible from the standpoint of good farm management. Bluegrass, white clover, and alfalfa are well suited if liberal quantities of phosphorus and lime are used. These plants furnish excellent pasture and are effective in increasing the organic-matter and humus contents, which consequently increase moisture absorption and circulation, thereby helping to control runoff. Grazing should be very carefully controlled in periods of adverse moisture conditions in order to prevent injury to the pasture and to tilth of the surface soil. Where amendments are applied in the proper kinds and quantities, weeds generally will be largely eliminated; but clipping in spring and fall may be necessary in some places. Check dams are necessary to control gullies.

If farm-management requirements make the use of this soil for tilled crops necessary, row crops should not be grown more than once in 7 or 8 years. Liberal applications of lime, phosphorus, and potash will be required; and organic matter and nitrogen should be maintained or increased by growing legumes and sod-forming grasses during much of the rotation. Barnyard manure is also effective in this respect and furnishes some potash in addition. Cover crops are very necessary in winter. Engineering practices for the control of runoff are required and contour tillage should be practiced. Strip cropping on the longer slopes may also be effective in controlling runoff and conserving moisture and soil material.

Talbott silt loam, steep phase.—Mapped in small or medium-sized irregularly shaped areas, this phase occupies only 310 acres on

the lower slopes of mountain ridges. The parent material has weathered from high-grade limestone of the Trenton formation. Native vegetation was a hardwood forest of oak, hickory, maple, beech, and black walnut. Slopes range from 30 to 60 percent, but are usually less than 40 percent. Areas occur on the northwest-facing slopes of Powell and Lone Mountains and on Wallen Ridge and on the southeast-facing slope of Poor Valley Ridge in association with the hilly phase, Talbott-Hayter silt loams, Armuchee soils, and Rough stony land (Talbott soil material).

The profile is similar to that of the hilly phase, but more of the surface layer has been removed by accelerated erosion. To a depth of 4 to 6 inches the surface layer is grayish-brown silt loam with a fine crumb structure. It is strongly acid in reaction, low in organic matter, and at least moderately deficient in lime, phosphorus, and potash. Small slabs of limestone rock are on the surface in some places.

The 18- to 24-inch subsoil is heavy compact yellowish-red silty clay with a weakly developed nut or lumpy structure. It is underlain by mottled yellowish-red silty clay, which is less compact and has a more distinctly developed nut structure than the above layer. Bedrock is at a depth of about 4 feet, but surface outcrops and ledges are rather common.

Runoff and erosion are difficult to control because of the steep slopes and the compact, slowly permeable subsoil, which causes much water to be lost in runoff. Where the soil is unprotected by vegetation, runoff is very rapid; and the water carries large quantities of suspended soil material, cutting gullies in many places.

Included variations are due to differences in the degree of erosion and to the presence of some sandy colluvial material in the surface soil. Where erosion is severe, all the original surface soil is missing and the upper part of the original subsoil is at the surface. In these places the surface is sticky and plastic when wet and hard and intractable when dry. In a few places where sandy soil material has washed from higher slopes onto the soil, the surface few inches are fine sandy loam in texture and sandstone rock fragments are present. These variations are not of sufficient magnitude to alter materially the management requirements from those of the normal type.

Use and management.—The present use of Talbott silt loam, steep phase, is fairly well adjusted to its physical suitability, but improvements are needed in management practices. Practically all the soil is cleared and used for pasture land. Fertilizer and other soil amendments are not ordinarily used, and other special management practices are not followed. Under present practices about 30 cow-acre-days of grazing may be expected. In the few places where tilled crops are grown, yields are very low.

Because this soil is difficult to work and conserve, it is best suited to pasture. Management requirements should insure adequate amendments, fertilizer, organic matter, and moisture in order to obtain good stands. Lime and liberal applications of phosphorus are required to obtain good stands of red clover, white clover, and bluegrass. When the sod-forming crops become established, they aid in controlling runoff and preventing loss of soil material by erosion. The organic-matter content and the water-absorbing capacity of the soil are in-

creased, further decreasing runoff. Grazing should be controlled so that good pasture stands can be maintained, and weeds should be controlled by clipping or other means to eliminate competition with the pasture plants for moisture and plant nutrients. Check dams are needed in the larger gullies. Shading by thin plantings of locust or black walnut may be beneficial on pastures.

Talbott silty clay loam, eroded phase.—This soil is on slopes of 7 to 15 percent on low rolling hills in the limestone valleys. Clayey limestone of the Black River and Stone River formations (9) underlies it. Surface drainage is fairly rapid, but internal drainage is moderately slow because of the heavy subsoil. Native vegetation was a mixed hardwood forest of oak, hickory, and maple. Medium-sized irregularly shaped areas of the 3,166 acres mapped are in Powell Valley and in the vicinity of New Tazewell, and small areas are in Cedar Fork and Little Sycamore Valleys and in the southwestern part of the county in the vicinity of Little Barren Church. It is associated chiefly with other Talbott soils and the miscellaneous land types of Talbott soil material, but in some places it is mingled with Dewey, Caylor, and Allen soils.

Much of the original surface layer has been lost by accelerated erosion. The present 3- to 6-inch surface layer is grayish-brown moderately friable silty clay loam with a fine granular structure. Reaction is strongly acid. The original organic-matter content was probably moderately low, but it has been greatly depleted by cropping and erosion losses. Good tilth is generally difficult to maintain because of the mixing of heavy subsoil material with the remaining surface soil. This material is sticky and plastic when wet and hard and intractable when dry. A small quantity of chert may be on the surface and in the soil. Small flaggy slabs of limestone are on the surface and bedrock outcrops are in some places.

The reddish-yellow subsoil is sticky plastic tenacious compact silty clay with a coarse nut or lumpy structure. When dry it is extremely hard and intractable. It is about 2 feet thick, and small black concretions are in the lower part. The substratum is yellow or reddish-yellow silty clay mottled with gray, ocher, and dark brown. It has a fairly well developed nut structure and is less sticky and tenacious than the above subsoil layer. Clayey limestone bedrock is at an average depth of 5 feet, but the rock floor is uneven and jagged and surface outcrops are in some places.

The maintenance of favorable tilth and moisture conditions is difficult. The tight compact subsoil greatly impedes the percolation of water, the penetration of roots, and the movement of air. Slow moisture movement causes alternate wet and dry conditions in the surface soil, and crops are injured by droughts or extended wet periods. Slow percolation of water through the subsoil layer causes heavy surface runoff and may result in serious soil erosion. As erosion becomes more severe, conditions for absorption and percolation of moisture become less favorable and the susceptibility to further erosion becomes increasingly greater.

Variations are chiefly due to differences in the degree of accelerated erosion. In many places nearly all of the original surface soil is missing and the present plow soil is heavy, sticky, and plastic; whereas

in the few areas only slightly eroded, the surface is moderately friable. Bedrock outcrops are more numerous in the more severely eroded areas, and the rock is at shallower depths.

Use and management.—In the past the use and management of Talbott silty clay loam, eroded phase, have not been well adjusted to the physical suitability of the soil, and little change has taken place in recent years. Practically all the soil is cleared; about 35 percent is used for corn, 25 percent for hay, 20 percent for pasture, 10 percent for other crops, and 10 percent is idle land. Very little burley tobacco is grown. Systematic rotation of crops is not commonly practiced—many farmers grow corn for a few years in succession followed by several years of idleness; others alternate corn and hay according to their farm needs.

Corn usually receives about 100 pounds an acre of 0-10-4 or 0-20-0 fertilizer, and small grains are treated similarly. Hay and pasture ordinarily receive no fertilizer. Very little of the soil used for tilled crops receives periodic applications of lime, but areas that are used chiefly for pasture are limed at fairly regular intervals. Mechanical means for the control of runoff are not commonly used, but tillage is generally on the contour. Under common prevailing management practices, acre yields of about 20 bushels of corn, 12 bushels of wheat, 750 pounds of burley tobacco, and 1 ton of lespedeza hay may be expected. Where lime is used in addition to other practices, 1 ton of red clover and 1½ tons of alfalfa an acre are obtained.

Requirements for good management include careful practices for (1) controlling runoff and erosion, (2) improving tilth of the surface soil, (3) improving moisture conditions for plant growth, and (4) increasing the humus, lime, and mineral plant-nutrient supplies. Where practical from the standpoint of good farm management the soil is best suited to hay and pasture crops, but under careful soil management it can be conserved under a rotation including inter-tilled crops once in 6 years. It is not well suited to tobacco, but corn followed by small grain seeded to a pasture or hay makes a desirable rotation.

Alfalfa, red clover, and sod-forming grasses—especially blue-grass—are effective in increasing the humus and nitrogen contents, improving tilth, increasing moisture-absorbing qualities, and preventing erosion. Cover crops should be on the soil in fall and winter. Grazing of pastures should be carefully controlled during periods of adverse moisture conditions. Potash and phosphorus in liberal applications are necessary for good growth of legumes and grasses. Lime is required. Runoff and erosion can be controlled largely by proper choice and rotation of crops and the use of adequate amendments, but in most places some other practices are necessary. Strip cropping is beneficial on some of the longer slopes, and tillage should always be on the contour. Terraces may be effective on some areas to control erosion, but they must be well planned and carefully maintained to be effective. Check dams are required to control gullies.

TYLER SERIES

The soil of the Tyler series is on old stream terraces in nearly level or slightly depressed positions. The parent material of old alluvium

has washed chiefly from uplands underlain by shale and some sandstone. All of the soil is in the valley of Big Sycamore Creek, Agriculturally, it is of slight importance because of its small acreage and limited use suitability.

The surface layer is light yellowish-gray silt loam. The subsoil is mottled yellowish-gray silt loam to somewhat gray or blue silty clay loam heavily mottled with yellow and brown. Acid shale is at variable depths. Only one type, the silt loam, is mapped.

Tyler silt loam.—Occurs on level or slightly depressed positions above present overflow on old stream terraces. Its parent material is derived from stream alluvium that has washed from uplands underlain by shale and some sandstone material. Slopes are less than 3 percent, and both internal and surface drainage are very slow. Native vegetation was a hardwood forest. All of the 115 acres mapped is in the valley of Big Sycamore Creek in small areas associated with Monongahela and Holston soils. Leadvale, Jefferson, Philo, and Atkins soils are on the adjoining colluvial slopes and bottom lands; and Montevallo, Lehew, and Muskingum soils are on the nearby uplands.

The surface 4 to 5 inches is light yellowish-gray floury silt loam. It is underlain by an 8- to 12-inch layer of yellowish-gray silt loam mottled with brown, yellow, and red. This grades into a somewhat compact gray or blue silty clay loam heavily mottled with brown and yellow. It is heavier and more plastic with increasing depths, although in places thin layers of sand and gravel may be present. Shale bedrock is at depths of a few to several feet. Organic-matter content is very low, and reaction is strongly to very strongly acid. Moisture conditions are unfavorable for the growth of most crop plants; water stands on the surface during all the wetter seasons of the year, but the surface layer may dry out late in summer.

Use and management.—At present all of Tyler silt loam is cleared and used chiefly for pasture. Redtop, common lespedeza, and various wild grasses are the chief pasture plants. No lime, fertilizer, or other amendments are ordinarily used; and yields are low and of poor quality. Both quality and quantity can be improved by good management, however, and most of the soil can be profitably used for grazing. If lime and phosphate are used in adequate quantities, a mixture of bluegrass and white clover is well suited. If a hay crop is needed, alsike clover might do fairly well. Surface drainage can be improved in many places by open ditch drains; and where it is improved, better stands of desirable pasture plants can be obtained and the grazing period is lengthened.

WAYNESBORO SERIES

The soil of the Waynesboro series occurs on the terraces of the Powell River and some of its larger tributaries. Slopes range from gently sloping to strongly rolling and erosion, from moderate to severe. Holston and Sequatchie soils are on the lower terraces, and soils derived from limestone and dolomite are on the associated uplands. This soil is better drained, more leached, and more oxidized than other terrace soils derived from sandy materials.

The profile is well developed. The surface layer is grayish-brown to light-brown friable fine sandy loam, and the subsoil is red or yellowish-red fine sandy clay. The substratum, which is several feet thick, is yellowish-red fine sandy clay mottled with gray, brown, and yellow. It contains beds of rounded sandstone gravel and sand and is underlain by limestone residuum or bedrock. The eroded phase of the fine sandy loam is the only type mapped.

Waynesboro fine sandy loam, eroded phase.—This soil is on high old stream terraces on slopes of 5 to 12 percent well above the present level of overflow. The parent material is derived from old alluvium washed from uplands underlain chiefly by acid shale and sandstone with some limestone material. Native vegetation was a hardwood forest of oak, hickory, and associated species with some shortleaf pine in the more droughty sites. Both surface and internal drainage are moderate. The 190 acres mapped are in a few areas of moderate size along the Powell River near Brooks Ridge and along Indian Creek in the northern part of the county. Holston and Sequatchie soils are on the lower terraces, and various soils derived from limestone and dolomite are on the adjoining uplands. A few small areas in Powell Valley are associated in a complex pattern with other soils of the terrace lands, bottom lands, and colluvial lands.

The surface 4 to 6 inches is grayish-brown to light-brown friable fine sandy loam. It is strongly acid in reaction and low in organic matter. In many places it is so thin that the upper subsoil is disturbed by tillage operations and mixed with the surface soil. In these places the present surface layer is dominantly reddish in color and is somewhat heavier in texture. Moisture conditions are fairly good, however, and favorable tilth is moderately easy to maintain. Some small sandstone fragments may be on the surface and in the soil, and small quartz or sandstone pebbles are numerous on the more severely eroded areas.

The red or yellowish-red fine sandy clay subsoil is about 2 feet thick and is underlain by several feet of yellowish-red fine sandy clay mottled with gray, brown, and yellow. Sandstone, quartz pebbles, and sand layers are present. In most places this material is underlain by limestone residuum or bedrock.

Several variations are mapped. About a third of the soil is on slopes of 2 to 5 percent. These areas are less eroded than the normal phase, and the subsoil color is lighter, being reddish yellow rather than red in most places. A few small areas in Powell Valley derived chiefly from limestone material are heavier and darker than the normal phase. Although some of these variations cause local differences in management requirements, they are not generally of sufficient importance or extent to necessitate additional soil separations.

Use and management.—The present use of Waynesboro fine sandy loam, eroded phase, is fairly well adjusted to its physical properties, but management practices are not designed to compensate for the deficiencies of the soil or to conserve it. All the soil is cleared and cultivated; it is used for corn, wheat, tobacco, hay, and vegetables. The general level of management is essentially the same as that on the adjoining upland soils on similar slopes. Crops are not ordinarily rotated; row crops are grown for a few years followed by hay, which is chiefly lespedeza but may be clover and timothy in a few places.

Tobacco is fertilized heavily, but corn and small grains receive only small quantities of fertilizer and hay crops receive none. Very little of the soil is ever limed. Tillage is roughly on the contour, but no other precautions for conserving moisture or preventing erosion are used. Under prevailing systems of management, acre yields of 20 bushels of corn, 13 bushels of wheat, 550 pounds of burley tobacco, $\frac{3}{4}$ ton of lespedeza, and 1 ton of mixed hay may be expected.

Management requirements are centered about proper selection and rotation of crops; use of lime, fertilizer, and other soil amendments; prevention of erosion; and conservation of soil moisture. Although the soil is derived from different kinds of materials and is lighter in texture throughout the profile, use suitability and management requirements are similar to those of Dewey silty clay loam, eroded phase.

USE, MANAGEMENT, AND PRODUCTIVITY OF CLAIBORNE COUNTY SOILS

The soils of the county are grouped into land classes based on the physical⁷ use suitability of the soils and into management groups based on management requirements. A table of estimated yields is included to show the expected yields of crops for the soils of the county under three different levels of management to enable the users of the report to compare the productivity of the same soil under different levels of management and of different soils under similar management. In the productivity table, the estimated yields are converted into indexes that will permit comparison of the productivity of soils of Claiborne County with those of other parts of the United States.

The physical properties of the soils determine or limit the ranges of their physical use suitability, and the use or uses, in turn, determine the requirements for good management. The way a soil is used and managed together with its physical properties determines largely, though not entirely, its productivity. It should be pointed out, however, that use, management, and productivity, although determined largely by the physical properties of the soils are not completely so, inasmuch as many other factors, as economic conditions, climate, and interest of the farm operators also are important.

Productivity as used in this section refers to the capacity of the soils to produce crops. The soil may be productive of a crop but not well suited to it, because of poor workability, poor conservability, or both. The five relative terms used to describe productivity are very high, high, moderate, low, and very low.

Soils of very high productivity have a good supply of available plant nutrients, moisture relations that are most nearly ideal, a reaction that approaches neutral, and conditions that are favorable for good root development. Soils defined as of high, moderate, low, and very low productivity are successively less favorable for plant growth.

⁷The term "physical" used in this section connotes such internal and external soil properties as texture, structure, consistence, reaction, content of essential plant nutrients, lime, and organic matter; kinds and quantities of micro-organisms, insects, and earthworms; moisture relations, slope, stoniness, erosion, and any other soil factors that might affect the kind and quantity of plant growth on the soils.

Workability refers to ease of tillage, harvesting, and other field operations. Texture, consistence, stoniness, and degree of slope are important among the properties that affect workability. The six relative terms used to describe workability are excellent, very good, good, fair, poor, and very poor.

Soils of excellent workability are generally light- to medium-textured, stone-free, nearly level soils that require a minimum of effort for tillage and harvesting operations. It is successively more difficult to perform normal farming operations on soils of very good, good, and fair workability, but such operations can generally be performed feasibly for crops requiring tillage, even on soils of fair workability. Silty clay or clay soils, hilly soils, or soils that contain enough stones to interfere seriously with cultivation are considered to have fair workability. Soils on which normal tillage operations can be performed only with great difficulty are considered to have poor workability. Such soils in this county generally have slopes in excess of 25 percent or are so stony as almost to preclude tillage with ordinary implements. Soils of very poor workability are so steep or so stony or both that tillage is generally limited to the use of hand implements.

Conservability refers to ease of maintenance of productivity and workability of the soil. The degree to which the soil responds to good management practices is reflected in the conservability of the soil.

The relative terms used to describe conservability are the same as those listed for use in describing workability. The ease with which the content of available plant nutrients can be maintained at a high level, the ease with which runoff and consequent loss of soil material and water can be controlled, and the ease with which good tilth and good conditions for tillage can be maintained are the principal factors considered.

Excellent conservability means that productivity and workability can be maintained with a minimum of intensity of management. Very good, good, and fair conservability, respectively, represent soil conditions that require successively more intensive management for conservation of productivity and workability, but both can generally be conserved under good management practices that are feasible under present conditions for crops requiring tillage. Poor conservability represents soil conditions such that productivity, workability, or both can be conserved when the soil is used for crops requiring tillage only by intensive management practices that are generally not feasible on most farms under present conditions. Very poor conservability represents the extreme of difficulty of conservation of productivity, workability, or both.

These three conditions—productivity, workability, and conservability—determine the physical suitability of the soils for agricultural use. An ideal soil for agriculture is one that is very productive of a large number of important crops, one that is easily worked, and one that can be conserved with a minimum of effort. On the basis of their relative physical suitability for agriculture the soils of Claiborne County are grouped in classes as shown in tables 6 and 8 and as defined in the section on Land Classification. Although no one of the classes is ideal for existing agriculture, the First-class soils more nearly approach that ideal than do Second-class soils. Likewise, the

soils of each succeeding class are farther from the ideal than those of the preceding class.

The relations among productivity, workability, and conservability are very complex in their influences on the physical suitability of soils for agricultural use. All soils of Claiborne County are short of ideal in respect to these three conditions, but they differ widely in degree of departure from this ideal. Moreover, the degree of departure of any one of the three conditions from the ideal may differ greatly from those of the other two. For example, a soil may be highly productive and easy to conserve, but very difficult to work; whereas another soil may be low in productivity and easily worked and conserved. Evaluation of these three conditions may place both soils in the same land class or physical use-suitability group.

Because of differences in departure of these three conditions from the ideal, however, soils of similar use suitability will differ considerably in management requirements, one requiring special practices to improve workability and the other special practices for increasing productivity. For this reason it is convenient to divide the use-suitability groups into groups of different management requirements and in a few cases to have soils of different land classes in the same management group. These groups of soils of similar management requirements are listed in table 6, and uses and management are described in some detail in the section on Soil Use and Management.

LAND CLASSIFICATION

The 87 units of mapping (soil types, phases, complexes, and miscellaneous land types) of the soil survey of Claiborne County are classified on the basis of physical characteristics that can be observed in the field.⁸ Some of these characteristics, such as color and structure, may be considered internal, whereas others such as slope and erosion may be considered external. Both internal and external characteristics may have significance in determining the physical capability of the soil unit. Soils that are widely separated in the soil classification may be relatively similar for agricultural use. It is necessary to interpret the characteristics of soils in terms of physical suitability for agriculture if the soil survey is to be useful in meeting farm problems.

The soils are placed in five land classes on the basis of relative physical suitability for agriculture under present conditions, considering the productivity, workability, and conservability of each. It is assumed that soils that are only moderately well suited both to crops requiring tillage and to pasture are better suited to agriculture than are soils that are poorly suited to crops but that are well suited to pasture. This assumption is made because soils that are well suited to crops are limited on more farms than soils that are well suited to pasture. If livestock should become more important in the agriculture of the area this assumption would tend to become less valid.

The soils are divided into two groups, in one of which productivity, workability, and conservability of the soils are sufficiently good for the soils to be considered at least fairly well suited to crops as well as

⁸ The method of classification of the soils into taxonomic units is described in the section on Soil Survey Methods and Definitions, page 25.

to pasture. In the other, one or more of the factors of productivity, workability, and conservability are sufficiently poor for the soils to be considered poorly suited to crops requiring tillage.

The first group is subdivided into three subgroups, which are designated as First-, Second-, and Third-class soils in decreasing order of suitability for agriculture.

The second group, which consists of soils poorly suited to the production of crops requiring tillage, is subdivided into two subgroups—Fourth- and Fifth-class soils. The first of these two groups consists of soils at least fairly well suited to the production of permanent pasture; the other, of soils that are poorly suited to permanent pasture and are probably best suited to forest.

Information obtained from the experience of farmers, soil surveyors, extension workers, experiment station workers, and others who work with the soil was used in placing the soils in these five land classes. Comparisons were made among the soils, considering productivity, workability, and conservability. For example, a farmer knows that some soils on his farm are better suited to agriculture than others. By comparisons of this nature within and among farms the soils were placed in the approximate order of their physical suitability for agriculture. For soils for which information based on experience is lacking, the rankings were arrived at by comparisons with soils of similar productivity, workability, and conservability for which information is available.

This grouping is not to be taken as a recommendation for use. Its purpose is to provide information as to the relative physical suitability of the various soils for the present agriculture of the county. Knowledge of a great many factors applying to a specific farm is necessary in making recommendations for land use on that farm.

FIRST-CLASS SOILS

First-class soils are very good for the agriculture of Claiborne County. They are good to excellent for crops requiring tillage and good to excellent for permanent pasture. All are relatively well supplied with plant nutrients when compared with other soils of the county, but the most fertile is responsive to additions of amendments for some crops. They contain more lime than most other soils of the county, but they are usually slightly deficient in this constituent; they are fairly well supplied with organic matter in comparison with other soils of the county. All are well drained, but their physical properties are such that they retain moisture well, and an adequate and even supply of moisture for plant growth is maintained. Good tilth is easily obtained and maintained, and the range of moisture conditions for tillage is comparatively wide. The physical properties of these soils favor normal circulation of air and moisture, and roots penetrate all parts of the subsoil freely.

None of these soils has any prominent adverse soil conditions. They are almost free of stone, the relief is favorable to soil conservation and tillage, and none is severely eroded or highly susceptible to erosion. Their natural productivity is relatively high, they are easily tilled, and the problem of conservation of soil fertility and of soil material itself is relatively simple under common farming practices. All are well

suiting to most of the exacting and intensive crops of the locality when grown under the prevailing systems of management. The total area of these soils is 1,784 acres.

SECOND-CLASS SOILS

Second-class soils are good for the agriculture of the county. They are fair to good for crops requiring tillage and fair to excellent for permanent pasture; they are moderately productive of most of the crops commonly grown in the county; their physical properties are moderately favorable for tillage, maintenance of good tilth, and normal circulation and retention of moisture. None occupies slopes greater than 12 to 15 percent; none is sufficiently stony to interfere seriously with tillage operations; and none is severely eroded. Each is moderately deficient in one or more properties that contribute to productivity, workability, or conservability; but none is so seriously deficient in any property that the soil is poorly suited to use for crops requiring tillage.

The deficiencies vary widely among the soils. Some are fertile but sloping and moderately eroded; others are almost level and uneroded but relatively low in content of plant nutrients or have restricted drainage. Management requirements differ widely among the soils because of the many different kinds of soils included. These soils are relatively similar in their suitability for agriculture, although the management practices by means of which their capability may be realized differ greatly. The total area of these soils is 21,698 acres.

THIRD-CLASS SOILS

Third-class soils are fair for the agriculture of the county. They are poor to fair soils for crops requiring tillage and are fair to very good for permanent pasture.

Each soil has workability, conservability, or productivity, one of which, or a combination of which, is sufficiently poor for its physical suitability for crops requiring tillage to be definitely limited. These soils are better suited to crops requiring tillage than Fourth-class soils and are less well suited to crops requiring tillage than Second-class soils. One or more of the conditions of low content of plant nutrients, low content of organic matter, low water-holding capacity, undesirable texture, structure, consistence, strong slope gradient, stoniness, or inadequate natural drainage limit the suitability for crops requiring tillage. Because of the diversity of characteristics among the soils of this group, management requirements differ widely within the group. The total area of these soils is 34,870 acres.

FOURTH-CLASS SOILS

Fourth-class soils are poorly suited to crops requiring tillage and are poor to very good soils for permanent pasture. They are poor for agriculture, mainly because of the limited number of uses to which they are well suited. Some of them may be the most important soils on some farms, however, where soils well suited to permanent pasture are needed.

Each soil of this group is so difficult to work or so difficult to conserve, or both, that management practices necessary for their success-

ful use for crops requiring tillage are not feasible on many farms under present conditions. On some farms, however, soils well suited to crops requiring tillage are so limited that it is necessary to crop Fourth-class soils. They are generally used for pasture on farms where enough land is available that is well suited to crops. Considerable acreage is used for crops, mainly on farms where soils better suited to the production of crops exist in acreages too small to satisfy the needs of the farm unit. The management of these soils used for crops is generally inadequate for good soil conservation. Management requirements, both for crops requiring tillage and for pasture, vary widely among the Fourth-class soils. The total area of these soils is 70,539 acres.

FIFTH-CLASS SOILS

Fifth-class soils are very poorly suited to the agriculture of the county. They are very poor soils for crops requiring tillage and are poor to very poor for permanent pasture. Each soil of this group is so difficult to work, so difficult to conserve, so low in productivity or has such combinations of these unfavorable properties that it is generally not feasible to use them for crops requiring tillage. Each is so low in content of plant nutrients or has such poor moisture relations, or both, that common pasture plants produce very little feed. These soils are apparently best suited to forest under present conditions even though they may be less productive of forests than soils of any of the preceding groups. Existing conditions of the locality or of the farm unit may require the use of some of these soils for pasture or for crops, in spite of the fact that they are poorly suited to those uses in their present conditions. The total area of these soils is 149,072 acres.

SOIL USE AND MANAGEMENT

The physical use suitability and most of the common practices and management requirements are discussed for each soil type in the section on Soils. The purpose of this section is to explain briefly some of the principles of soil use and management and to assemble in one place a summary of the management practices commonly followed and a statement of the major requirements of good management of soils of the county.

The term "soil use" as used here refers to broad farm uses as (1) for crops requiring tillage, (2) for permanent pasture, and (3) for forests. The term "soil management" refers to such practices as (1) choice and rotation of crops; (2) application of soil amendments, as lime, commercial fertilizer, manure, and crop residue; (3) tillage practices; and (4) engineering practices, for the control of water on the land.

The farmer who attempts to readjust the use and management of his soils is confronted with a number of circumstances that affect his ability to make adjustments. Among these are (1) the size and type of farm; (2) the physical character of the land, including the pattern of soils on the farm; (3) the surrounding social and economic conditions, as transportation, market, church, and school facilities; (4) the immediate demand for a cash income to meet taxes,

indebtedness, support of family, and other expenses; (5) the relation between prices of farm products and other commodities; (6) the farm operator's facilities and resources for operating purposes, including buildings, equipment, kind and number of livestock, cash, credit, and other items; (7) the farm operator's ability, preferences, and other characteristics; (8) community cooperation with respect to drainage, water disposal, marketing, buying, and other operations; and (9) tenure status of the operator.

A farmer, as an individual, can make only those adjustments toward better management that are possible within his limited financial and personal ability. In the suggestions for management practices for the various soils, it is recognized that certain of these may not be feasible for many farmers in the county under present conditions. Some may use combinations of management practices, different from those indicated in this section but better suited to their particular conditions. The management requirements of soils of each group are discussed with respect to two broad uses—(1) crops that require tillage and (2) permanent pasture.

Management requirements are discussed for crops in terms of a rotation or rotations considered to be well suited to the soils. The management of the soil for one crop of the rotation generally has an effect on the production of other crops in the rotation. Management requirements of the soil for each crop, therefore, are dependent not only on the properties of the soil and characteristics of the crop but also on the management that has been practiced on other crops in the rotation.

The suggested management practices are to be used as the definitions of management for columns C of the tables of expected yields and productivity ratings. They represent one or more particular kinds of management that are thought to be good, but many different combinations of management practices in various intensities of application can be used in most cases to attain the same objectives of production. The proper choice depends upon conditions of the farm as a unit. For example, nitrogen may be maintained by the use of legumes, manure, commercial fertilizer, or combinations of the three. The best method for maintaining nitrogen depends on the kind of farm as well as on soil conditions.

In the land classification part of this section the soils are grouped according to their relative physical suitability for general farm use, whereas in this part they are placed in 14 separate groups on the basis of their management requirements as shown in table 6.

The soils within one of the physical land classes or use groups may vary widely in their management requirements and responses. Soils may have the same degree of physical use suitability for farming, but the management practices necessary may be very different among them because the characteristics of the several soils of the group are different. Conversely, soils of similar management requirements may have different physical suitability for farm use. For example, stoniness may have a greater influence on the physical suitability of a soil for crops requiring tillage than it has on the management requirements of the soil to produce those crops.

The Tennessee Agricultural Experiment Station, the Tennessee College of Agriculture Extension Service, and the University of Ten-

nessee have issued many publications, bulletins, and circulars that relate to the soils and crops of Tennessee. Some of the information in these various publications is related to specific soils and crops, whereas much of it is of a more general nature and should be carefully studied before it is applied to any specific soil or crop. The following list includes many of these publications.

Tennessee Agriculture Experiment Station bulletins:

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| 78. The Soils of Tennessee | 149. Fertilizers and Manure for Corn |
| 114. The Oat Crop | |
| 141. The Comparative Values of Different Phosphates | 176. A New Explanation of What Happens to Superphosphate in Limed Soils |
| 142. The Effects of Various Legumes on the Yield of Corn | |

Tennessee Agricultural Experiment Station circulars:

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| 5. The Soils of Tennessee | 34. Increasing the Profits from Phosphates for Tennessee Soils |
| 6. The Value of Farmyard Manure | 45. Balho Rye |
| 10. A Select List of Varieties of Farm Crops | 49. Korean Lespedeza |
| 11. Rates and Dates of Planting for Tennessee Farm and Garden Crops | 52. Rye for Pasture and Seed in Tennessee |
| 33. The Effect of Certain Soil Conditions on the Yield and Quality of Burley Tobacco | 60. Fertilizer for Tennessee Soils |
| | 65. The Effect of Shade on Pasture |

Tennessee College of Agriculture Extension Service publications:

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| 133. Lime and Prosperity of the Farm | 214. Small Grain in the Contour Furrows on Lespedeza Sod |
| 144. The Farm Woodland in Tennessee | 216. Making High Quality Hay |
| 161. Burley Tobacco Culture | 217. A Pasture Program for Tennessee Farms |
| 188. Winter Cover Crops for Pasture and Soil Conservation | 218. Farming Terraced Fields |
| 197. A Land Use and Soil Management Program for Tennessee | 219. Plowing for Terrace Maintenance |
| 208. Lime, Phosphate and Legumes in an Agricultural Conservation Program | 227. Field Mechanics of Terracing |
| 209. The Place of Terraces in Tennessee Agriculture | 228. Terrace Outlet Waterways |
| 210. Increasing Farm Returns | 233. How to Build and Conserve Your Soil with the Aid of the AAA |
| 213. Alfalfa in the Tennessee Farm Program | 234. Conservation and Use of Manure on Tennessee Farms |
| | 245. Planning the Farm Lay-Out and Cropping System |

Tennessee College of Agriculture Extension Service leaflet:

19. Soybean Seed Production in Tennessee

College of Agriculture, University of Tennessee bulletins:

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| 5. Determining Soil Types on Tennessee Farms | 6. Getting Acquainted with the Origin and Nature of Farm Soils in Tennessee |
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The following groups of soils are based on similarities of management requirements for crops requiring tillage. Management requirements for permanent pasture as well as for crops requiring tillage are discussed for each group. Generally the requirements for permanent pasture are also similar among the soils of each group. The soils of different groups may also have similar management requirements for pasture, although they have striking dissimilarities for crops requiring tillage. This arises from the more exacting management requirements that result from tillage of most soils of this county.

MANAGEMENT GROUP 1

Management group 1 includes good to excellent crop and pasture soils. All the soils are high to very high in productivity and are easily worked and conserved. They have gentle slopes and are not susceptible to severe erosion. All are relatively high in lime, organic matter, and plant nutrients as compared to soils of most other groups, and all have favorable moisture conditions for plant growth. This group is of relatively small importance to the agriculture of the county because of the small total acreage.

Management requirements.—The soils of group 1 are suited to intensive use and a wide variety of crops, including corn, burley tobacco, soybeans, small grains, alfalfa, red clover, crimson clover, sweetclover, and various vegetable crops. When other management requirements are met, the soils can be conserved and their productivity maintained or increased under rotations including a row crop in alternate years. Winter cover crops and green-manure crops are useful as a means of conserving soil moisture, improving tilth, and as a source of nitrogen and humus.

These soils are more fertile than any others of the county, but they are generally slightly to moderately deficient in lime, phosphorus, nitrogen, and possibly potash. Properly conserved barnyard manure is an excellent source of both nitrogen and potash and also serves to increase the humus supply of the soils, but it should be supplemented with some form of phosphate fertilizer to obtain the correct balance of plant nutrients. Where an adequate supply of manure is not available, such crops as corn, tobacco, small grains, and vegetables will respond to complete commercial fertilizer. Legumes require phosphorus and potash but, when properly inoculated, no nitrogen, inasmuch as they "fix" nitrogen from the air. Lime is necessary to obtain good stands of legumes and increases the yields of most other crops if other management requirements are met.

Good tilth is easily maintained and tillage operations can be carried on over a fairly wide range of moisture conditions without seriously impairing the physical properties of the soils. Controlling erosion and conserving soil moisture are not serious problems on these soils when crops are properly chosen and adequate amendments are used. Mechanical devices for these purposes are not ordinarily needed, but contour tillage is a good practice wherever feasible. Careful management of adjoining upland, however, is necessary to control runoff and prevent flooding and covering Caylor silt loam, gently sloping phase, and Emory silt loam by heavy subsoil material from the eroding uplands.

Even though the soils of this group are very well suited to pasture land, their use for this purpose is largely precluded by their being so well suited to crops. When used for pasture, the chief management requirements consist of supplying amendments, chiefly lime and phosphorus, to suitable pasture plants. Other requirements include proper control of grazing and scattering of droppings. On pastures that receive adequate amendments and are properly grazed, the problem of weed control is not serious; but occasional mowing may be necessary to remove excess herbage and undesirable plants.

MANAGEMENT GROUP 2

The soils of management group 2 on the whole are good for crops and pasture. They are moderate in productivity and as a group have good workability and conservability but less favorable properties in these respects than the soils of group 1. All these soils are on rolling uplands or old sloping colluvial lands in limestone valleys on slopes of 8 to 15 percent, except for Talbott silt loam which has slopes of less than 8 percent. These soils are excluded from group 1 largely because of the heavy, tough subsoil and shallowness over bedrock. All these soils are slightly to moderately eroded and are moderately susceptible to erosion; all are moderately deficient in organic matter and essential plant nutrients; and all are medium to strongly acid. Moisture supplies are generally adequate for good plant growth, but crops may be injured by lack of moisture during prolonged droughts. This group of soils is of moderate agricultural importance because of its fairly large acreage and rather favorable physical properties.

Management requirements.—The soils of group 2 are suited to moderately intensive use. They can be used for growing corn, small grains, burley tobacco, legumes, and grasses. When other management requirements are met, they can be conserved under rotations including a row crop once in 3 to 5 years. Leguminous and grass sod-forming crops are useful in each rotation as a means of controlling runoff and increasing or maintaining the nitrogen and humus supplies.

The soils of this group are moderately deficient in lime, phosphorus, potash, and nitrogen. They appear to be adequately supplied with most of the so-called minor elements, but some unknown deficiencies in these respects may exist. Such crops as corn, small grains, and burley tobacco require moderate to large quantities of complete fertilizers. Grass hays have similar requirements, but legumes ordinarily need only phosphorus and potash. Lime is necessary to obtain good stands of legumes, improves yields and quality of other crops, and is probably best applied just prior to seeding the legumes in the rotation. Barnyard manure is an excellent source of nitrogen and potash if supplied in sufficient quantities and supplemented with some form of phosphorus to obtain the proper balance of plant nutrients.

Moderate care is required in the selection of proper moisture conditions for working these soils, but otherwise good tilth is easily maintained. The proper selection and rotation of crops together with the use of soil amendments are partly effective in controlling runoff, but some special practices for this purpose are required. Contour tillage is an effective aid in conserving soil and moisture. On the longer slopes, strip cropping is useful for the same purposes. In some places, properly planned and constructed terraces that are carefully maintained are also effective. Large gullies can best be stabilized by the use of check dams and by planting permanent cover crops.

Good pastures can be easily established and maintained on these soils. Grass and legume mixtures, including bluegrass, orchard grass, white clover, lespedeza, hop clover, and many other plants are well suited. Applications of lime, phosphorus, and possibly potassium are needed on most pastures, but mixtures that include a fair proportion of legumes ordinarily require no nitrogen. Subsequent applications of potassium may not be required. Careful control of grazing

during periods of adverse moisture condition is important both as a measure to protect pasture stands and to prevent injury to the physical properties of the soils. On pastures that have received adequate amendments and are properly grazed, weed control is not a serious problem, but during seasons of rapid growth, clipping to remove excess herbage and eradicate weeds may be necessary.

MANAGEMENT GROUP 3

The soils in management group 3 are good for crops and pasture. As a group they have moderate productivity, good workability, and good conservability. All the soils in the group are on rolling ridge tops on the cherty ridge part of the county. They are generally somewhat lower in natural fertility than the soils of group 2, but they are lighter in texture and more friable, especially in the subsoil, and are less eroded and less susceptible to erosion. These soils are low in lime, essential mineral plant nutrients, and organic matter. They have slopes of 5 to 12 percent and are slightly to moderately eroded; they absorb and retain moisture well, and moisture moves freely in the soil to permit an adequate supply for plants under normal conditions. Crops, however, may be injured to some extent by lack of moisture during periods of even moderate drought. The acreage of the soils in this group is large, and the group is of considerable importance to the agriculture of the county.

Management requirements.—Although the soils of group 3 are relatively low in natural fertility they have favorable physical properties and respond to good management. They are suited to all or nearly all the crops commonly grown in the county and seem to be especially well fitted to growing burley tobacco, alfalfa, vegetables, and fruits. The soils can be conserved under a rotation including a row crop once in 3 years. A row crop seeded to small grain followed by a legume is a useful rotation. Legumes and green-manure crops should have an important place in the cropping system, inasmuch as they are effective in maintaining or increasing the supplies of humus and nitrogen, conserving moisture, and preventing erosion.

These soils are low in nitrogen, phosphorus, potash, and lime. Wherever barnyard manure is available, it should be applied in liberal quantities as a source of nitrogen, potash, and humus and as a means of improving tilth and increasing the moisture-holding capacity of the soils. Some form of phosphorus should be used in conjunction with it to obtain a correct balance of plant nutrients. Where manure is not available or is available in only limited quantities, complete commercial fertilizer is needed by corn, small grains, tobacco, vegetables, and grasses. Legumes and legume-grass mixtures require phosphorus and potash but no nitrogen if they are properly inoculated. Lime is necessary to insure success with legumes. Fertilizer should be used in quantities adequate for the needs of the particular crop to which it is applied rather than in large quantities at infrequent intervals.

Good tilth is easily maintained, and tillage can be carried on over a wide range of moisture conditions without injury to the soils. Where crops are properly selected and rotated and receive adequate supplies of fertilizer and other amendments, runoff and erosion are greatly reduced, but a few special practices for water control are needed. All tillage operations should be done on the contour if feasible. On the

longer slopes where the soils are intensively used, strip cropping is effective in conserving moisture and preventing erosion. Terraces may be useful in some places; but they must be carefully planned, constructed, and maintained to be effective.

These soils are well suited to pasture, although their suitability to more intensive use prevents their use for pasture land in most places in the present agriculture of the county. Grasses and legumes, including lespedeza, various clovers, bluegrass, orchard grass, timothy, and redtop are among the pasture plants suited to the soils. Phosphorus and lime in moderate quantities at relatively frequent intervals are needed. Initial seedings of pasture will likely need potassium as well; but subsequent applications may not be necessary. Control of grazing is important, especially during the drier summer months and early in fall, when overgrazing may result in injury to the stand. Occasional mowing of pastures may be needed in spring and fall to remove excess forage and to eradicate weeds.

MANAGEMENT GROUP 4

Management group 4 includes good crop soils and fair to good pasture soils. As a group they are moderate in productivity and have good workability and good conservability. They are on colluvial lands and low stream terraces with slopes of 2 to 15 percent. The greatest acreage of soils, however, has slopes near the middle of the range. As a group, these soils have somewhat better moisture relations than those of group 3, and they are less eroded and apparently less susceptible to erosion. They are relatively low in lime, organic matter, and mineral plant nutrients but are slightly more favorable in these respects than the soils of group 3. Moisture is readily absorbed and circulated and fairly well retained by these soils. The supply of moisture is apparently maintained or replenished to some extent by seepage from surrounding upland slopes so that an adequate supply for plant growth is available except during periods of severe and prolonged drought. Because of the moderately large acreage, fairly favorable properties, and ready response to good management the soils of this group are important to the agriculture of the county.

Management requirements.—Because of their favorable physical properties, moderate fertility, and slight susceptibility to erosion the soils of group 4 are suited to intensive use. They can be used for growing a wide variety of crops including corn, small grains, and all kinds of legumes and grasses suited to the section. Burley tobacco and vegetables do especially well. The soils can be conserved when used for row crops every year or in alternate years. When the soils are so used, crimson clover, winter oats, rye, or similar crops should be sown to protect the soil in winter and to be turned under in spring as a source of nitrogen and as a means of increasing the humus supply. Where it is practical from the standpoint of farm management to use longer rotations, the rotation of row crop followed by a small grain seeded to hay is well suited to the soils in the group.

Although these soils are younger and less leached than the associated soils of the uplands, they are generally at least moderately deficient in phosphorus and nitrogen and probably potash. Corn, small grains, and grasses need fertilizer containing moderate quantities of nitrogen and potash and large quantities of phosphate. Tobacco

and vegetables have similar requirements except that the proportion of potash should be somewhat higher. Legumes and legume-grass mixtures that have been properly inoculated need no nitrogen, but they do require large quantities of phosphorus and potash. Barnyard manure is an excellent source of humus, nitrogen, and potash if applied in sufficient quantities and supplemented with some form of phosphorus to obtain the correct balance of plant nutrients. These soils are generally acid, and need lime in most places to produce good stands of legumes. It is probably advisable, however, to determine the acidity of these soils by an accurate chemical quick test and use the results as a guide as to whether lime is needed and the quantity that should be applied.

Where crops are properly selected and rotated and treated with adequate amendments, these soils ordinarily have no special problems of erosion control, although tillage should be on the contour wherever practical. In many places, the management of adjoining upland soils directly affects the soils of this group inasmuch as they may be covered with heavy subsoil material washed from adjoining eroding hillsides thereby greatly impairing their workability and fertility and reducing their productivity. These soils should be protected from such overwash by all feasible methods, which should center about improving the use and management of the associated upland soils.

The suitability of the soils of this group to crops largely precludes their use for pasture, especially since they are in sections of the county where the proportion of soils suited to crops is relatively small. Pasture-management requirements are similar to those described for the soils of group 3. They involve chiefly supplying lime, phosphorus, and potassium to properly selected pasture mixtures; properly controlling grazing; and mowing to remove excess herbage and to eradicate weeds.

MANAGEMENT GROUP 5

The soils of management group 5 are good for crops and pasture. As a group they are moderate in productivity, easily worked, and very easily conserved. All are on first-bottom lands except Ooltawah silt loam, which is in the bottom of depressions, and all are subject to annual overflow or flooding. Roane silt loam and Pope fine sandy loam are well drained, but the rest are imperfectly drained. The Ooltawah, Lindside, and Roane soils are from medium to slightly acid and generally are fairly well supplied with lime as compared with the soils of the adjacent uplands, whereas the Pope and Philo soils are strongly acid and are low in lime.

All soils of the group have a fair supply of organic matter and essential plant nutrients, but the Philo soils are somewhat more deficient in this respect than the remaining soils in the group and for this reason are rated as Third-class rather than Second-class soils as are the other soils. Most of the soils in the group, however, have some deficiencies in nitrogen, phosphorus, potassium, and lime. Imperfect drainage limits somewhat the variety of crops that can be grown, but an adequate supply of moisture for plant growth is generally available, and crops are not injured by droughts so easily as on the adjacent uplands. Moderately favorable physical properties, fairly large acreage, and the fact that many of the soils are in areas where those

well suited to crops are limited make the soils of this group very important in the agriculture of the county.

Management requirements.—Favorable workability and conservability make the soils of group 5 suitable for intensive use, but the variety of crops that can be grown is limited by their imperfect drainage and susceptibility to overflow. Wheat, corn, soybeans, crimson clover, alsike clover, redbud, bluegrass, white clover, and many vegetables do fairly well. They are generally poorly suited to growing alfalfa, red clover, barley, and burley tobacco. Row crops, including corn and truck crops, can be grown every year or in alternate years, but some green-manure or winter cover crops are needed to maintain or increase humus and nitrogen. Where practicable from the standpoint of good farm management, a 3- to 4-year rotation of corn, wheat, and hay is suited to the soils. Tobacco can also be used in this rotation but is less well suited to these soils than those with better drainage.

Even though these soils receive annual increments of soil material they are generally deficient in lime, phosphorus, potash, and nitrogen, as the upland soils from which the materials are washed are relatively low in fertility. In general all crops require moderate to large applications of complete fertilizer, except legumes, which need large quantities of phosphorus and potash but no nitrogen. Lime is necessary to obtain satisfactory stands of legumes and increases the yields and improves the quality of other crops.

All these soils are easily maintained in good tilth, although tillage operations may be delayed in spring during wet periods because of unfavorable moisture conditions owing to the imperfect drainage of the soils. These soils are not ordinarily susceptible to erosion, but it may be necessary to stabilize stream banks in some places by the use of suitable vegetation or engineering structures. The range of use suitability and general productivity of these soils can be improved by artificial drainage, but the advisability of drainage and the kinds of drain to use on any particular area will depend upon many factors including cost, feasibility of drainage from an engineering standpoint, and kinds and quantities of other soils on the farm.

The soils of this group are well suited to pasture. Fairly good pastures can be obtained with very few special practices other than plowing and seeding. The use of lime and phosphorus, however, will improve the quality and increase yields of pasture, excellent bluegrass and clover pastures being obtained by the use of these materials. Control of grazing is important during the wetter seasons to prevent trampling of the pastures and injury to physical properties of the soils. Mowing to eradicate weeds and remove excess herbage is necessary.

MANAGEMENT GROUP 6

The soils of management group 6 are good for crops and for pasture. They have moderate productivity, fair to good workability, and poor to fair conservability; they are on rolling uplands and sloping old stream terraces, with slopes of 8 to 15 percent. These soils differ from those of group 2 chiefly in being more eroded and more susceptible to erosion. All the soils are moderately to severely eroded; and over most of their extent the subsoil is turned by plowing and other tillage operations. Most of the soils are at least moderately deficient in lime, organic matter, and essential plant nutrients. Favorable tilth is mod-

erately difficult to maintain, and the range of moisture conditions for tillage is narrow. Moisture absorption is less favorable than on the soils of the groups previously discussed, and losses through runoff are large so that crops are easily injured by droughts. Because of moderate natural fertility and ready response to good management, the soils of this group are important to the agriculture of the county.

Management requirements.—Because of the difficulty in conserving them, the soils of group 6 are not suited to intensive use. They are suited chiefly to close-growing small grain and hay crops, but under proper management row crops can be grown once in 4 to 7 years. Wheat, oats, barley, alfalfa, red clover, alsike clover, and timothy are among the crops that will do well. These soils are less well suited to burley tobacco than those of either group 1 or 2, and because of their heavy-textured plow layers and moderate tendency to droughtiness they are poorly suited to most vegetable crops. A rotation of corn or tobacco, wheat or other small grain, and hay is well suited to the soil. Where limed, these soils are well suited to clover and alfalfa, and they will fit well into the suggested rotation.

Good tilth is moderately difficult to maintain on these soils. If plowed when too wet they become puddled or cloddy. When they are dry, tillage operations of any kind are difficult. If plowed in fall, freezing and thawing will likely serve to improve tilth, but this advantage is probably more than offset by the increased runoff and erosion, so that fall plowing is not generally a good practice. Where the soils are much of the time in close-growing crops, grass, and small grain, runoff and erosion are greatly reduced, but further special measures for their control are required. Contour tillage should be practiced wherever feasible. On some of the longer slopes, a system of strip cropping may be useful. Broad-base terraces that are carefully planned and constructed and properly maintained are effective in preventing erosion and conserving soil moisture. All large gullies should be stabilized. Check dams are useful for this purpose. They may be built of wood, brush, stone, or concrete, depending upon the size of the gully, the availability of materials, and other factors. Vegetation on the gully banks is also effective. Certain trees, chiefly pine and black locust, are useful, and Bermuda grass, kudzu, and sericea lespedeza are among the plants that can be used effectively.

All the soils of this group are well suited to pasture. Bluegrass, orchard grass, redtop, white clover, and other pasture legumes grow well. Lime, phosphorus, and potassium are needed to establish good pasture, and additional supplies of lime and phosphorus are needed periodically to maintain them. Very careful control of grazing is necessary, especially in dry seasons, to avoid injury to pasture stands. Clipping is necessary, especially in wetter seasons, to remove excess forage and eradicate weeds.

MANAGEMENT GROUP 7

The soils of management group 7 have moderate productivity and good conservability and workability. The Holston, Monongahela, and Taft are on nearly level to gently sloping old stream terraces; whereas the Leadvale soils are on gently sloping to sloping colluvial lands. All these soils have somewhat restricted internal drainage, and all except the Holston have a distinctly developed pan or mottled

layer. All these soils are derived from silty materials and all except the Leadvale have old strongly leached profiles. They are generally strongly acid in reaction and are low in organic matter, lime, and essential plant nutrients, but because of mild slopes, they are only slightly eroded and are not susceptible to severe erosion. The soils absorb moisture readily, but the hardpan layer restricts water movement to some extent, and the soils are characterized by being alternately wet and dry. Favorable moisture conditions, however, for the growth of most crops, with the possible exception of alfalfa and other deep-rooted legumes, are ordinarily maintained. Even though the acreage of these soils is not large and they are only fairly well suited to crops, they are very important from the standpoint of agriculture inasmuch as they are chiefly in parts of the county where soils suited to crops are limited.

Management requirements.—The imperfect drainage of the soils of group 7 limits their range of use suitability. They are suited chiefly to corn and hay, although wheat may do fairly well under careful management, and burley tobacco is successfully grown on the Leadvale soils by some farmers. Soybeans, alsike clover, sorghum, lespedeza, and redtop should do fairly well on most of these soils. They can be conserved under rotations that include a row crop once in 3 years if other management requirements are met. A rotation of corn, wheat, and lespedeza is well suited to most soils. Alfalfa is not suited to the soils, but some legume, as alsike clover or possibly red clover, can be used in the rotation instead of lespedeza. Where the demand for cropland is great, row crops can be successfully grown in alternate years if the soils are carefully managed in other respects.

In general these soils are deficient in lime, phosphorus, potash, and nitrogen. They are apparently fairly well supplied with the minor elements, but very little definite information is available, and deficiencies that are now unknown may exist. Corn and small grains need complete fertilizer containing moderate quantities of nitrogen and large quantities of phosphorus and potash. Legumes or legume-grass mixtures for hay or pasture require relatively large quantities of phosphorus and potash but no nitrogen if properly inoculated. Barnyard manure is an excellent source of potash and nitrogen, but it should be supplemented with a phosphorus fertilizer to obtain the correct balance of plant nutrients. It is also effective in increasing humus, thereby improving tilth and moisture conditions. Lime is needed to neutralize soil acidity. Its use is essential to success with legumes, and the yields of all crops will be increased.

Plowing and other tillage operations may be delayed in spring because of unfavorable moisture conditions, but otherwise all operations may be easily accomplished on these soils. None of them is susceptible to serious erosion. With the possible exception of the need for contour tillage on Leadvale silt loam, sloping phase, no special practices for prevention of erosion are needed where suitable crops are properly fertilized and receive adequate amendments. It is probable that some measures for improving surface drainage can be used profitably on most of these soils. The type of drain that is needed on any particular soil area should be determined by competent engineers. Elaborate tile drainage systems are too costly when the in-

creases in yields and range of use suitability are considered, and open ditch drains are best suited to these soils.

All these soils are fairly well suited to pasture, though possibly less so than those of the preceding groups. Native pasture consists largely of broomsedge, other wild grasses, and weeds, but with the use of lime, phosphorus, and potassium, grass-legume seedings can be established and maintained. Careful control of grazing during extremely wet and dry periods is necessary to avoid damage to soil tilth and the physical properties of the soils. Occasional clipping will be needed to control weeds.

MANAGEMENT GROUP 8

The soils of management group 8 include fair cropland and fair pasture land. As a group they are low in productivity and have fair workability and good conservability. They differ from the soils of group 3 chiefly in being more stony or cherty and lower in natural fertility. All the soils have sufficient chert or stone on the surface and in the soil layers to interfere materially with tillage; all are low in lime, phosphorus, potassium, nitrogen, and organic matter; and all are strongly acid. The slopes are from 5 to 12 percent. Water is absorbed readily, but it is not retained well, and crops are injured by droughts of even moderate duration. Surface runoff and erosion are somewhat less than on the noncherty types or phases of the same soil series, but in many places much of the fine material in the original surface layer has been lost by accelerated erosion, and the present surface layer is largely a mixture of chert and subsoil material. In these places the soils are very cherty. In spite of only fair suitability to crops and pasture, these soils, because of large acreage and wide distribution, are important to agriculture.

Management requirements.—The soils of group 8 are suited to less intensive use than those of group 3 because of the less favorable properties of the soils and their lower response to good management. These soils are suited to growing corn, small grains, burley tobacco, legume hays, grasses, and some vegetables. Tree fruits, principally peaches, are grown successfully on soils similar to some of these in other parts of Tennessee, and it may be assumed that they will do well in Claiborne County although there is no specific evidence to that effect. A 4- or 5-year rotation of a row crop followed by small grain seeded to a legume or grass for hay or pasture is well suited to the soils. Sod-forming grasses and legumes should have an important place in the rotation for the purpose of conserving moisture, preventing erosion, and increasing the supplies of humus and nitrogen.

These soils are similar to those of group 3 in their requirements for amendments. Small grain, corn, tobacco, vegetables, and grasses require complete fertilizer; but legumes need only phosphorus and potash, inasmuch as they "fix" nitrogen from the air if properly inoculated. Where barnyard manure is available and is used in sufficient quantities in conjunction with some form of phosphate fertilizers, other fertilizers are needed in small quantities or not at all. In addition to furnishing nitrogen and potash, manure increases the supply of humus and helps to improve tilth and moisture conditions. Soil acidity must be neutralized by the use of lime

before success with legumes can be assured. These soils apparently have adequate supplies of the minor elements, although little definite information is available concerning them. Fertilizer should be applied in moderate quantities to meet the immediate needs of a particular crop rather than in large quantities at infrequent intervals.

Tillage operations can be carried on over a fairly wide range of moisture conditions without impairing tilth. Tilth conditions are generally only fair, however, because of the large quantity of stone or chert on the surface and in the soils. Some improvement can be obtained by removal of the larger rock fragments, but it is generally impractical to remove all of them. Where suitable crops are properly rotated and treated with adequate amendments, the control of runoff is already largely accomplished, but a few additional special practices are needed. On the steeper, longer slopes, strip cropping is an effective means of preventing erosion and conserving soil moisture. Contour tillage should be practiced where feasible. It is likely that terraces on these soils are not generally practical, but in some places they may be effective if they are carefully planned and constructed and properly maintained.

Under a good system of management, fairly good pastures can be obtained on these soils, but native pastures consist chiefly of broom-sedge and other plants. Good stands of grass-legume mixtures, including orchard grass, redbud, lespedeza, and various clovers can be obtained by the use of lime and complete fertilizer. After pastures are established, additional nitrogen may not be needed if the mixture contains a fair proportion of legumes, but periodic application of other amendments will be required to maintain good stands. Careful control of grazing is important during dry seasons to avoid injury to pasture stands, the somewhat droughty character of these soils being responsible for the limited growth during dry periods. Where adequate amendments are used and grazing is properly regulated, weeds are few on pastures on these soils, but occasional clipping for weed eradication may be necessary. Hoof injuries by the sharp fragments of chert on the chertier parts of many of these soils inhibit grazing by cattle, and may make the use of the soils for pasture purposes impractical even though they may produce good yields of forage.

MANAGEMENT GROUP 9

The soils of management group 9 make fair cropland and fair pasture land. They have low to moderate productivity, poor to fair workability, and fair to good conservability and differ from the soils of group 3 chiefly in having steeper slopes and on the whole being somewhat more eroded. Slopes range from 12 to 25 percent, a large proportion of the total acreage having slopes in the middle and upper parts of this range. All except the wooded parts are at least moderately eroded, and all are at least moderately susceptible for further erosion. All have some deficiencies in lime, phosphorus, potassium, nitrogen, and humus, and all but the Dewey soil are of light texture and are easily maintained in good tilth. Water is readily absorbed and retained except on the more severely eroded areas, but crops are injured by droughts of moderate duration because of the large loss of water in

runoff. In parts of the county where soils suited to crops are scarce, these soils are of large agricultural importance, but over the county as a whole they are of only moderate importance, because of the small acreage and limited range of use suitability.

Management requirements.—Their stronger slopes make the soils of group 9 more exacting in management requirements and more limited in range of use suitability than those of any of the preceding groups. Wherever practical from the standpoint of good farm management, these soils are best used entirely for small grain and sod-forming forage crops, but row crops can be grown once in 7 to 10 years if other management requirements are met. Wheat, oats, barley, alfalfa, red clover, lespedeza, timothy, orchard grass, bluegrass, white clover, and corn are among the crops suited to the soils. Fruit trees, if properly cared for, may produce well. Tilt and moisture conditions are not generally favorable for burley tobacco and vegetable crops. Where the soils are kept in sod crops most of the time, erosion is prevented, soil moisture is conserved, and the supplies of nitrogen and humus are increased.

These soils, like those of groups 3 and 8, are low in nitrogen, phosphorus, potash, and lime and require similar fertilization. Small grains require complete fertilizer as do grass crops. Legumes or legume-grass mixtures require phosphorus and potash but no nitrogen if they are properly inoculated. As on other soils, barnyard manure in adequate quantities is an excellent source of nitrogen, potash, and humus but needs to be supplemented with some kind of phosphorus to obtain the proper balance of plant nutrients. There are no serious deficiencies in the minor elements, but unknown shortages may exist because few data are available. Lime is necessary to obtain good stands of legumes and also to improve the yield and quality of other crops. It is best applied in small or moderate quantities at rather short intervals. Fertilizer should be supplied in small or medium applications to meet the need of a particular crop rather than in large quantities at long intervals.

Tillage is moderately difficult because of the strong slopes and eroded condition. Moisture conditions for plowing need to be carefully chosen to avoid further impairment of tilt. The soils should never be left bare of vegetation during winter or at any other time of the year for periods longer than necessary to accomplish needed tillage operations. Erosion control and moisture conservation can be attained largely through correct choice, rotation, and fertilization of crops, but some other special practices are needed. Both hay and small grains should be seeded on the contour. Tillage operations also should be on the contour wherever feasible. Where it is necessary to raise row crops, some system of strip cropping is needed wherever practicable. In general, it is not feasible to build terraces on the strong slopes of these soils. Gullies can be controlled by check dams and by planting pine, black locust, and other suitable trees and various kinds of herbaceous vegetation, including grasses, kudzu, and sericea lespedeza.

This group of soils is suited to pasture, but less well so than most groups already described. Management requirements are similar to

those described for group 3. They are concerned chiefly with supplying needed amendments to suitable pasture mixtures, controlling grazing, and eradicating weeds.

MANAGEMENT GROUP 10

The soils of management group 10 are poorly suited to crops, but they are fair to good pasture lands. They are low to moderate in productivity, moderately difficult to work, and easy to conserve. All are poorly drained except Alluvial soils, undifferentiated, in which imperfect drainage, stoniness, or low natural fertility have been developed to the extent and in such combinations that they are unsuited to use as cropland. Alluvial soils, undifferentiated, Dunning, Melvin, and Atkins soils are on first bottom lands; Robertsville and Tyler on low terraces; and the Guthrie on depressions or lime sinks in the uplands. The Dunning and Melvin are apparently fairly well supplied with lime and essential plant nutrients, but the others in the group are at least moderately deficient in these respects. Both surface and internal drainage are very slow, and in most places cannot feasibly be improved to the point that tilled crops can be grown. Fair yields of grasses and legumes for pasture, however, can be obtained in most places. These soils are not of great importance to the agriculture of the county, because of the small acreage and limited range of use suitability.

Management requirements.—Natural pastures on most of the soils of group 10 consist chiefly of broomsedge, wild marsh grasses, and sedges, with cattails, sweetflag, and similar plants in the wettest sites, except that on the Melvin and Dunning a bluegrass-white clover mixture is in many places. These pastures furnish grazing throughout spring, summer, and fall; but the quality is poor to fair and the carrying capacity low to medium. The first step in pasture improvement on these soils should be directed toward improving moisture conditions. This can be accomplished largely through the use of open ditch drains, which are effective in removing much of the surplus surface water.

After drainage has been improved, seedings of bluegrass and white clover can be expected to do fairly well with liberal applications of lime and phosphorus. Redtop and lespedeza can be grown with small quantities of amendments, but the pasture obtained is of lower quality. Weeds should be controlled by mowing the pastures once or twice in each grazing season. Even under good management, the quantity and quality of pasture that can be obtained will vary considerably among the various soils in the group, depending on natural fertility, as will also the grazing period, depending on drainage conditions. In most places the use of the soils of this group for cropland is not feasible under present conditions, but fair yields of corn may be obtained from the Dunning and Melvin soils.

MANAGEMENT GROUP 11

Management group 11 includes soils and land types that are poorly suited to crops but are good pasture lands. They are moderate in productivity but have poor workability and fair conservability. Oc-

curing on undulating to rolling uplands in limestone valleys, they are fairly well supplied with lime and mineral plant nutrients but have some deficiencies in these respects. Because of the heavy texture of the soil material and the relatively large quantity of bedrock outcrop, the soils have only fair properties of moisture absorption, and plants are injured by droughts of short duration. The rock outcrops and heavy texture also make tillage very difficult. This group is of considerable agricultural importance because of its moderately large acreage and its suitability to pasture production.

Management requirements.—In some places it may be most economical to use the lands of group 11 in their natural conditions, but in others to undertake more intensive management. Seeding to bluegrass and white clover will aid in pasture improvement. Lime and phosphorus in moderate quantities will greatly increase the proportion of bluegrass and white clover in the pasture mixture and thus produce pasture of higher quality and yield. In places applications of potassium may be needed to establish good pastures, but thereafter additional fertilizer may not be needed if droppings are scattered. The use of fertilizer materials together with carefully controlled grazing will eliminate most weeds, but mowing may be necessary to eradicate some of them. In some places, outcrops may be high enough to prohibit the use of a mowing machine; but cutting by hand can be accomplished everywhere. Even under good management, the carrying capacity of pastures on these lands is greatly reduced during the warmer, drier summer months, and during this period provision should be made for grazing part of the livestock on temporary pastures. Thin shading by widely spaced black locust and walnut trees is beneficial to pastures. It is not feasible to use these soils for growing crops under existing conditions.

MANAGEMENT GROUP 12

The soils of management group 12 are poorly suited to cropland, but they make good pastures. They have moderate productivity, poor to very poor workability, and poor to fair conservability. All are on hilly and steep slopes, chiefly on the lower scarp slopes of valley mountains bordering limestone valleys but to some extent on the slopes of hills in the valleys. All have a fair supply of lime, phosphorus, potassium, organic matter, and nitrogen; but most of them have some deficiency in these respects. All cleared areas are at least moderately eroded and are susceptible to further erosion. Moisture conditions favorable for plant growth are maintained with difficulty under tilled crops, but under close-growing grasses and legumes, moisture is retained and circulated fairly well. Good tilth is also maintained with difficulty under tilled crops. These soils are moderately important to the agriculture of the county because of their large acreage and suitability to use as pasture land.

Management requirements.—Both the quality and yield of pastures on soils of group 12 can be greatly increased by good management. Plowing and seeding to a suitable grass-legume mixture is the first step toward establishing good pastures on many. Lime and phosphorus are necessary to obtain and maintain good stands of bluegrass and white clover, which are the plants best suited for permanent pas-

ture, and potassium may be needed to establish new seedings and on old heavily grazed pastures. Mowing a few times during the grazing season will serve to eradicate weeds. Grazing should be so controlled that intense use will not injure the stands during dry seasons. Where adequate amendments are used on suitable plants and grazing is carefully controlled, erosion will be reduced and moisture conditions so improved that the yields and quality of pastures will be gradually improved also. Generally, no special practices for runoff control are feasible or needed other than the stabilization of gullies by means of check dams and suitable vegetation. It is likely that thin shading by widely spaced walnut and black locust trees will benefit the pastures.

MANAGEMENT GROUP 13

Management group 13 includes soils that are poorly suited to crops but are fair pasture lands. As a group they have low productivity, poor to very poor workability, and poor conservability. All are on hilly and steep slopes in the cherty ridge sections of the county, except Lehigh fine sandy loam, hilly phase, which is on comby ridges. They differ from the soils of group 12 chiefly in being lower in natural fertility. All the cleared parts are moderately eroded and at least moderately susceptible to further erosion; all are strongly acid and low in nitrogen, phosphorus, potassium, lime, and organic matter; all are either sufficiently cherty to interfere materially with tillage or have steep slopes in excess of 25 percent gradient; and all absorb water readily, but many do not retain it well because of the strong slopes and the light-textured, open, porous character of the soils. Plants are injured by even moderate droughts. Although at best these soils have only fair physical properties, they are of considerable agricultural importance because of their large acreage.

Management requirements.—The requirements for proper use and management of the soils of group 13 are variable. In a few places it may be necessary and advisable to use them for tilled crops; whereas in others, local conditions may make them more suitable for forestry. In general, however, they are best used for pasture, and their management requirements are largely concerned with this use. A mixture of grasses and legumes is best suited to these soils. Timothy, redbud, orchard grass, bluegrass, white clover, lespedeza, and hop clover are among the plants that may do fairly well. Plowing and seeding to the desired mixture is necessary to establish the pastures. Lime, phosphorus, and probably potash are needed in moderate quantities at relatively frequent intervals to obtain good stands and satisfactory yields of grasses and legumes.

Where the soils are eroded, the use of check dams and suitable vegetation will stabilize large gullies. Soil moisture conditions are relatively poor because of the rapid rate of runoff and the permeable subsoil. Grazing therefore should be very carefully controlled during periods of drought, for injury to the pasture stands would lead to denudation of the soil and greatly increase the susceptibility to erosion. As on other pasture soils, the control of weeds will be largely accomplished through the use of correct amendments and properly

controlled grazing; but clipping a few times each year may be advisable. On many of these soils the large quantity of chert may so inhibit movement of cattle that their use for pasture is not feasible even though fair to good stands may be obtained.

Where the need for land makes it necessary to use these soils for crops, management requirements will be exacting. Long rotations, consisting chiefly of close-growing small grains and hay crops, are best suited to the soils; but if they are carefully managed otherwise, row crops can be grown once in 7 years. Corn, wheat, oats, lespedeza, red clover, timothy, and redbud will produce fairly well if properly managed. On similar soils in some other parts of Tennessee tree fruits do fairly well and would probably be fairly successful in Claiborne County, if ready markets made their production desirable. Moderate applications of a complete fertilizer will be needed by all crops to meet the needs of the individual soils, which is preferable to large applications once or twice during the rotation. Lime also is needed.

The selection of suitable crops and the use of proper rotations and needed amendments will be largely effective in controlling erosion, but some special practices for this purpose are probably needed on most areas of these soils. Contour tillage conserves moisture and soil material in practically all places. On the longer slopes, a system of strip cropping may be practiced for water control. In some places hillside ditches may be useful in diverting runoff from fields on these soils; but in most places they are of questionable value. Where they can be used to advantage, they must be very carefully planned, constructed, and maintained.

MANAGEMENT GROUP 14

Management group 14 includes all the Fifth-class soils. All are very poorly suited to cropland and poorly suited to pasture land; all are low in productivity, very poor in workability, and poor in conservability; and all have some unfavorable soil properties, such as steep slope, chertiness, stoniness, erosion, strong acidity, or poverty in essential plant nutrients, or some combination of these properties so developed that they are not suited to use in the present agriculture. These soils are best used for forests, even though they may be less productive of trees than the soils of most of the groups previously described.

Management requirements.—The management requirements of the soils of group 14 are concerned chiefly with forestry problems. Forest management is described in detail in the section on Forests. Extreme need for land may necessitate the use of some areas of some of these soils for growing crops or pasture even though they are not well suited physically to such use. In such places, management requirements will be similar to those described for group 13.

The above management groups, showing the soil types under each, their productivity, workability, conservability, and physical use suitability in relative descriptive terms, are shown in table 6.

TABLE 6.—*Management grouping; ¹ general productivity, workability, and conservability in relative descriptive terms; and physical use suitability classification of the soil types, phases, complexes, and miscellaneous land types of Claiborne County, Tenn.*

Management group and soil	General productivity	Workability	Conservability	Physical use suitability
Management group 1:				} First-class soils (good to excellent cropland; good to excellent pasture land).
Emory silt loam.....	Very high.....	Excellent.....	Excellent.....	
Dewey silt loam.....	High.....	Very good.....	Very good.....	
Caylor silt loam, gently sloping phase.....	do.....	do.....	do.....	
Management group 2:				} Second-class soils (fair to good cropland; fair to excellent pasture land).
Caylor silt loam.....	Moderate.....	do.....	Good.....	
Allen loam.....	do.....	Good.....	do.....	
Dewey cherty silt loam.....	do.....	do.....	Very good.....	
Talbott silt loam.....	do.....	do.....	Good.....	
Caylor stony silt loam.....	do.....	Fair.....	do.....	
Management group 3:				} Third-class soils. (See below.)
Bolton silt loam, rolling phase.....	do.....	Good.....	do.....	
Fullerton silt loam.....	do.....	do.....	do.....	
Claiborne silt loam, rolling phase.....	do.....	do.....	do.....	
Fullerton loam.....	do.....	do.....	do.....	
Management group 4:				
Greendale silt loam.....	do.....	do.....	Very good.....	
Sloping phase.....	do.....	do.....	Good.....	
Sequatchie fine sandy loam.....	do.....	Very good.....	Very good.....	
Sloping phase.....	do.....	Good.....	Good.....	
Management group 5:				
Ooltewah silt loam.....	High.....	do.....	Very good.....	
Lindside silt loam.....	do.....	Very good.....	do.....	
Roane silt loam.....	Moderate.....	do.....	do.....	
Pope fine sandy loam.....	do.....	Excellent.....	do.....	
Philo fine sandy loam.....	do.....	Very good.....	do.....	
Philo stony fine sandy loam.....	do.....	Good.....	Good.....	

Management group 6:				
Waynesboro fine sandy loam, eroded phase	do	do	Fair	} Second-class soils. (See above.)
Dewey silty clay loam, eroded phase	do	Fair	do	
Etowah silty clay loam, eroded phase	do	do	do	} Third-class soil. (See below.)
Sequoia silty clay loam, eroded phase	do	do	do	
Talbott silty clay loam, eroded phase	do	do	Poor	
Management group 7:				
Holston fine sandy loam	do	Good	Good	} Second-class soils. (See above.)
Leadvale silt loam	do	do	do	
Sloping phase	do	do	Fair	} Third-class soils (poor to fair cropland; fair to very good pasture land).
Monongahela silt loam	do	Very good	Good	
Taft silt loam	do	do	do	
Management group 8:				
Clarksville cherty silt loam	Low	Fair	do	} Third-class soils (poor to fair cropland; fair to very good pasture land).
Clarksville loam	do	Good	do	
Fullerton cherty silt loam	do	Fair	do	
Fullerton cherty loam	do	do	do	
Hartsells stony fine sandy loam	do	do	do	
Jefferson stony fine sandy loam	do	do	do	
Sloping phase	do	do	do	
Management group 9:				
Bolton silt loam	Moderate	do	do	} Third-class soils (poor to fair cropland; fair to very good pasture land).
Dewey silty clay loam, eroded hilly phase	do	Poor	Fair	
Fullerton loam, hilly phase	Low	Fair	do	
Claiborne silt loam	Moderate	do	do	
Fullerton silt loam, hilly phase	Low	do	do	

¹ For detailed discussion of management groups, see pp. 167 to 181.

TABLE 6.—*Management grouping; ¹ general productivity, workability, and conservability in relative descriptive terms; and physical use suitability classification of the soil types, phases, complexes, and miscellaneous land types of Claiborne County, Tenn.—Continued*

Management group and soil	General productivity	Workability	Conservability	Physical use suitability	
Management group 10:					
Alluvial soils, undifferentiated.....	do.....	Good.....	Good.....	Fourth-class soils (poor cropland; poor to good pasture land).	
Dunning silty clay loam.....	Moderate.....	Fair.....	do.....		
Melvin silt loam.....	do.....	do.....	do.....		
Atkins silt loam.....	Low.....	do.....	do.....		
Guthrie silt loam.....	do.....	Poor.....	do.....		
Robertsville clay loam.....	do.....	Fair.....	do.....		
Tyler silt loam.....	do.....	do.....	do.....		
Management group 11:					
Colbert silty clay loam, eroded phase.....	Moderate.....	Poor.....	Poor.....		
Smooth stony land (Talbot soil material).....	do.....	do.....	Fair.....		
Rolling stony land (Talbot soil material).....	do.....	do.....	do.....		
Management group 12:					
Armuchee silt loam.....	do.....	do.....	do.....		
Steep phase.....	do.....	Very poor.....	Poor.....		
Dewey silty clay loam, eroded steep phase.....	do.....	do.....	do.....		
Talbot-Hayter silt loams.....	do.....	Poor.....	Fair.....		
Steep phases.....	do.....	Very poor.....	Poor.....		
Talbot silt loam:					
Hilly phase.....	do.....	Poor.....	Fair.....		
Steep phase.....	do.....	Very poor.....	Poor.....		
Management group 13:					
Bolton silt loam, steep phase.....	do.....	do.....	do.....		
Clarksville cherty loam, hilly phase.....	Low.....	Poor.....	Fair.....		
Clarksville cherty silt loam, hilly phase.....	do.....	do.....	do.....		
Fullerton cherty loam, hilly phase.....	do.....	do.....	do.....		
Fullerton cherty silt loam, hilly phase.....	do.....	do.....	do.....		
Claiborne silt loam, steep phase.....	Moderate.....	Very poor.....	Poor.....		
Fullerton silt loam, steep phase.....	do.....	do.....	do.....		
Fullerton loam, steep phase.....	Low.....	do.....	do.....		
Lehew fine sandy loam, hilly phase.....	do.....	Poor.....	Fair.....		

Management group 14:

Fullerton cherty silt loam, steep phase	do	Very poor	Very poor	} Fifth-class soils (very poor cropland; poor to very poor pasture land; best suited to forests under present conditions).
Fullerton cherty loam, steep phase	do	do	do	
Clarksville cherty silt loam, steep phase	Very low	do	do	
Clarksville cherty loam, steep phase	do	do	do	
Muskingum stony fine sandy loam	do	do	do	
Deep phase	do	do	Poor	
Rough stony land (Talbot soil material)	do	do	do	
Lehew fine sandy loam	Low	do	Very poor	
Montevallo shaly silt loam	Very low	do	do	
Hilly phase	do	do	do	
Rough gullied land:				
Talbot soil material	do	do	do	
Montevallo soil material	do	do	do	
Limestone rockland:				
Rolling	do	do	Poor	
Rough	do	do	Very poor	
Stony colluvium (Muskingum soil material)	do	do	do	
Rough stony land (Muskingum soil material)	do	do	do	
Mine dumps	do	do	do	

¹ For detailed discussion of management groups, see pp. 167 to 181.

ESTIMATED YIELDS AND PRODUCTIVITY RATINGS

Estimated Yields and Productivity Ratings show in tables 7 and 8 the yields of crops on the soils of the county under three different levels of management. The tables compare yields of different soils of the county under the same levels of management or the same soils under different levels of management; they show crop responses that can be expected from different levels of management on given soils; and they compare the soils of Claiborne County with those of other parts of the United States. The data do not show the relative importance that the different soils have in the agriculture, because they do not take into account the individual soil acreages. Neither can they show the total production of crops by soil areas without consideration of the acreage of the various soils used for each crop. They cannot be interpreted directly into land values, inasmuch as these are affected by distance to markets, relative prices of farm products, and many other considerations. When used in conjunction with other pertinent information, however, the data presented may assist in arriving at land values, total present production of crops by soil areas, and potential production capacity of soil areas.

In columns A, the yields of crops given are those that represent the expected averages without the use of manure, amendments, or beneficial crop rotations. In columns B, the yields given are those expected on the average over a period of years under the present prevailing practices of soil management. These practices are not the same on all soils nor are they the same for any given soil in different parts of the county or on different farms, but the practices described in the section on Soils under the individual mapping units and in the section on Soil Use and Management are representative of current management practices.

The yields given in columns B are based largely on observations made by members of the soil survey party; on information obtained by interviews with farmers and other agricultural workers who have had experience with the soils and crops of the county; and on comparisons with yield tables for other counties in Tennessee with similar soils. Specific crop yield data by soil types are not generally available, but the summation of local experience will give fairly reliable estimates of the yields that may be expected under the management commonly practiced. For some crops, yield information of any kind is very scarce. This is especially true of sorghum, vegetables, potatoes, sweet-potatoes, apples, peaches, and the carrying capacity of pastures.

In columns C, the yields given are those that represent the expected average yields of crops under good management. The term "good management" refers to the proper choice and rotation of crops; the correct use of commercial fertilizer, lime, and manure; proper tillage methods; the return of organic matter to the soil; and mechanical means of water control.

Present knowledge of the requirements for good management of specific soils for specific crops is limited, but some of the deficiencies of the soils are known with reasonable certainty, and the probability of other deficiencies is fairly well established. From this relatively meager information, some of the requirements for good management are presented in the section on Soils under the discussion of the indi-

vidual soil types and phases and in the section on Soil Use and Management. Both the requirements of different crops on the same soil and the same crop on different soils may be different. What is good management for an individual farm and its soils depends not only on the kind of soil but the extent and distribution of each kind; the combination of enterprises in the farm business; location of the farm relative to markets and other facilities; prices; and several other factors. It is apparent, then, that the requirements for good management of any particular soil cannot be rigidly defined because these requirements vary among the individual farms. In general, however, the management requirements described for the different soils in the section on Soil Use and Management have fairly wide application to the soils for which they are given.

Inasmuch as good management cannot be rigidly defined and because information about yields of crops under conditions that may approach good management is scarce, the expected yields in columns C are based largely upon estimates of men who have had experience with the soils and crops. The factors considered in making these estimates are the known deficiencies of the soil and the increases in yields of the crops that may be expected when these deficiencies are corrected within practical limits. These limits cannot be precisely defined nor can the response of a given crop on a given soil to the improved management practices be precisely predicted. Furthermore, some unknown deficiency that is not being corrected may materially affect yields, which in columns C give some idea of the responses that may be expected from good management. They may be used as production goals that might be attained by feasible good management practices. The means of attaining this goal may vary somewhat, but in general it consists of some combination of the good management practices listed in the section on management. Practically every soil in Claiborne County, under more intensive management, will bring profitable increases in yields.

The expected yields of the various soils are converted into productivity indexes in table 8, in which the soils are grouped according to their physical suitability for agricultural use.

The rating compares the productivity of each of the soils for each crop to a standard of 100. This standard index represents what might be considered a good average yield in areas of commercial production in the United States. An index of 50 indicates that the soil is about half as productive of the specified crop as is the soil with the standard index. Soils treated with amendments, as lime or commercial fertilizer, or unusually productive soils may have indexes of more than 100 for some crops.

The indexes of the productivity rating table are the expected yields expressed as percentages of the standard yields adopted for the Nation as a whole—

$$\text{Productivity rating index} = \frac{\text{expected yield}}{\text{standard yield}} \times 100$$

The standard yield for each crop is given at the head of the column for that crop. Columns A, B, and C under each crop refer to three levels of management and correspond to similar columns in the table of expected yields for which the levels of management are defined.

WATER CONTROL ON THE LAND

Water control on the land deals, in the broadest sense, with regulating the supply of water and soil moisture toward the end of maintaining or improving favorable soil conditions for plant growth. Water control on the land can be accomplished by (1) control of runoff, (2) artificial drainage, (3) irrigation, and (4) protection from floods. The number and combination of these measures that are needed vary from one locality to another, from farm to farm, and among the different fields on the same farm. In Claiborne County, neither irrigation nor protection of stream bottom lands are problems of sufficient extent or importance to be of practical interest, so that the problems of water control on the land include controlling runoff and artificial drainage.

The problem of runoff control is much greater in Claiborne County than that of artificial drainage. Estimates indicate that about half the area of the county has problems in controlling runoff. These problems exist on all the cleared soils of the uplands and on the more sloping soils of the terrace and colluvial lands. Only one-half of 1 percent of the county has soils so poorly drained that they cannot be used for growing crops in their present condition. These soils are on bottom lands, in depressions and lime sinks, and on low terraces. An additional 2 percent of the soils in similar positions are imperfectly drained. On these the variety of crops that can be grown is limited and yields and workability are adversely affected.

CONTROL OF RUNOFF

Runoff is that part of the rainfall that flows off the surface of the land in visible streams. The rate and quantity of runoff is determined by the total rainfall and its intensity and duration; the slope of the land; the number and kind of natural drainageways; the properties and thickness of the soils and underlying geologic substrata; and the kind and quantity of vegetation on the land. When man removes the natural vegetation and uses the land for growing crops and for pasture the rate and quantity of runoff is accelerated to varying degrees.

In general, on all but the most level lands, this increased rate of runoff, if uncontrolled, will result in marked unfavorable changes in the soils. Accelerated soil erosion is accompanied by such changes as loss of lime, plant nutrients, and humus; inhibition of microbiological activity; and impairment of tilth and soil moisture conditions.

The primary aim of runoff control is therefore to prevent soil erosion, thereby conserving soil moisture, lime, organic matter, plant nutrients, and the soil material itself; to maintain or improve tilth conditions; and to accelerate microbiological activity and the formation of humus. These ends can be attained largely through proper land use and management, although in certain places specific measures designed solely for erosion control may be needed.

The least erosion is in the Cumberland Mountain section, where the hilly and steep lands are in forest; whereas the most severe erosion is in the cleared hilly and steep uplands in the shale knobs in the southeastern part of the county. In the limestone valleys all the cleared uplands and stream terraces are eroded to some degree. The cleared rolling uplands of the cherty ridge sections are moderately eroded in

most places. The hilly and steep slopes that are cleared are generally severely eroded, but where they are in forest they are virtually uneroded. The forested slopes of the valley mountain ridges and the comby ridges are essentially uneroded, but where they are cleared, erosion is severe.

Estimates indicate that over the county as a whole about 50 percent of the soils are uneroded or only slightly eroded. These uneroded soils include most of those of the Muskingum series, the forested part of the Lelew soils, and the forested parts of the Fullerton, Clarksville, Claiborne, Bolton, Talbott, and Armuchee soils on hilly and steep slopes. They also include most of the soils of the bottom lands; a part of those of the colluvial and terrace lands, including the Pope, Philo, Atkins, Roane, Lindside, Melvin, Emory, Ooltewah, and Guthrie; and Sequatchie, Jefferson, and Leadvale soils on nearly level or slightly sloping lands. All the remaining soils of the county are eroded to some degree. About 15 percent of them are slightly to moderately eroded, but there are no large gullies and only a few small ones. Soils having this kind of erosion include the sloping phases of Leadvale, Greendale, and Sequatchie soils; Dewey, Hayter, and Talbott soils on undulating slopes; a part of the Fullerton, Claiborne, Clarksville, Bolton, and Caylor soils with rolling relief; and a small part of the Fullerton, Talbott, and Armuchee soils on hilly slopes that have been in pasture most of the time since they were cleared.

From 25 to 75 percent of the surface soil is missing, and widely spaced deep gullies are on 27.5 percent of the soils of the county. This type of erosion includes most of the Dewey, Talbott, Sequoia, Allen, Etowah, and Waynesboro soils on rolling slopes; a part of the Bolton, Claiborne, Fullerton, and Caylor soils on similar slopes; and some of the cleared parts of Dewey, Talbott, Armuchee, Fullerton, and Clarksville soils on hilly and steep slopes. On about 6 percent of the county more than 75 percent of the surface soil is missing and gullies too deep to obliterate by tillage are numerous. This kind of erosion is on a small part of the Etowah, Allen, Dewey, Talbott, and Sequoia soils on rolling slopes; and on some of the cleared parts of Talbott, Armuchee, Fullerton, Claiborne, Clarksville, Talbott, Dewey, and Lelew soils on hilly and steep slopes. About one-fourth of 1 percent of the county has been reduced to a close network of gullies. This is largely hilly and steep land originally covered with soils of the Dewey, Fullerton, Talbott, and Montevallo series.

A summary of these estimates shows that only 20 percent of the soils suited to growing crops, that is the First-, Second-, and Third-class soils, are uneroded. These uneroded soils are chiefly on the bottom lands, colluvial lands, and more level terrace lands; but a large proportion of them are affected to some extent by erosion, as they are covered in many places by heavy subsoil materials washed from adjoining eroded uplands to the extent that their productivity is reduced and their workability impaired. Hence practically all the soils suited to crops are adversely affected to some degree, directly or indirectly, by accelerated erosion. Only 10 percent of the Fourth-class soils are uneroded. These uneroded areas consist chiefly of poorly drained soils on the stream bottom lands, but small uncleared areas of the uplands are included. In short, 85 percent of the land suited

to crops and pasture has unfavorable properties developed to some degree because of accelerated erosion. Likewise, 23 percent of the Fifth-class soils are eroded to some extent. The 77 percent of the uneroded Fifth-class soils are those that have remained in forest.

The eroded condition of the soils of the county is evidence of failure to control runoff. Heavy annual rainfall, a large part of which comes in torrential downpours, on the strongly rolling, hilly, and steep lands, coupled with the improper use and poor management of these lands are the factors responsible. Inasmuch as rainfall and soil and land characteristics are natural phenomena that cannot be controlled to any extent, it is evident the erosion can be prevented and that the soils can be restored to their original or a higher level of productivity only by improved land use and management. Some practices that bear directly or indirectly on the problem of controlling runoff and erosion are discussed briefly in the following paragraphs.

Maintaining forest trees and grasses and close-growing legumes is one of the most effective means of controlling runoff and preventing erosion. Forests function in several ways. The forest canopy interrupts the fall of the water and breaks the force of its impact with the land surface. Forest mold and litter further break the impact and absorb large quantities of water. They also add large quantities of organic matter to the soil and thus greatly increase its water-holding capacity, as do the channels left by decayed roots and the burrows of insects, earthworms, and other organisms. The tree rootlets serve as a binding agent in the soil. To be most effective forests should be protected from fire and grazing by livestock, thereby preventing the destruction of the forest litter. In Claiborne County, reforestation as a means of preventing further soil erosion should be considered for all the cleared Fifth-class soils, including the hilly and steep upland soils, most of the stony land and rockland types, and the severely eroded lands.

Grasses and close-growing legumes are effective in much the same way as forests in preventing excessive runoff. They break the force of the rainfall, catch and hold soil particles, increase the content of organic matter and the water-holding capacity of the soil, and bind the soil mass with their roots. Since, however, they are more exacting in their requirements for moisture and plant nutrients, they can be used successfully only on soils of the less strongly sloping lands and on those of at least moderate fertility. These plants can be used to good advantage as permanent cover on all the sloping and hilly upland soils rated Fourth-class and in the rotations on most of the croplands. Slope, present erosion, natural fertility, and the specific needs of a particular farm program are factors that should be considered in determining the frequency and length of time that sod crops should remain on cropland.

Lime, although used chiefly for neutralizing soil acidity, functions both directly and indirectly as a factor in controlling runoff. It functions indirectly by neutralizing soil acidity and by increasing the availability of phosphorus and certain other plant nutrients, thereby so increasing the vigor of plant growth and improving conditions for bacterial activity as to increase the humus content and water-holding capacity of the soils. Mineral fertilizer functions in a similar manner by stimulating plant growth and microbiological

activity, whereas barnyard manure is a direct means of increasing the humus supply and water-holding properties of the soil. All these materials should be effective in helping to control runoff on all upland pasture and crop soils.

Proper selection and rotation of crops is the first step in solving the problem of preventing erosion and conserving soil moisture. On rolling and strongly rolling soils of the uplands and stream terraces, close-growing small grains, grasses, and legumes should be grown as much of the time as is practical from the standpoint of good farm management. The soils should be bare of vegetation as little as possible and covered with some close-growing crop during fall and winter. Cover crops and green-manure crops should be included in the rotation to be plowed under as a means of maintaining or increasing the supplies of humus and nitrogen, thereby improving tilth and the moisture-holding capacity of the soil.

Strip cropping may aid in preventing erosion in many places. Close-growing small-grain and hay crops and clean-cultivated crops are grown in alternate long narrow strips that run across the line of slope and approximately on the contour. By this means the slope is broken up into several short segments. The close-growing crops serve to slow the velocity of runoff waters so that soil material from the clean-cultivated strips is dropped. This system of farming can be used most effectively on soils that are on long, rolling, or strongly rolling slopes of the uplands and old terrace lands.

The measures described in the preceding paragraphs are concerned chiefly with the use of vegetation as a means of preventing erosion. In many places it is necessary to use certain mechanical devices, including such structures as terraces, dams, and contour furrows, either by themselves or in conjunction with the control methods previously discussed.

Terraces are probably the most common and in many places the most effective of the mechanical devices used for controlling runoff. A terrace is essentially an earth ridge with a channel above it, placed approximately on the contour of a slope. A terrace serves to intercept and store or divert water that falls on the land, with the purpose of preventing soil erosion and excessive loss of soil moisture. In Claiborne County, terraces of the drainage type, that is, with slight gradient and so constructed that excess water will be removed from the fields, are the needed type. Terraces are not a universal solution to the problems related to controlling runoff and preventing erosion. They must be very carefully constructed with proper outlets and be properly maintained. In Claiborne County terraces cannot be used to advantage on slopes of more than 15 percent gradient, nor should they be used on soils with thin surface layers that are the result either of natural causes or of accelerated soil erosion. They can be used to advantage on soils of the Dewey, Talbott, Sequoia, Fullerton, Bolton, Claiborne, Clarksville, Caylor, Etowah, and Allen series on gentle to strongly rolling slopes that are not too severely eroded, but they are not suited to use on severely eroded areas of these soils nor on any soils with hilly and steep slopes.

Contour furrowing is another device for retaining and distributing soil moisture over fields. Furrows or small ridges are constructed across the slope on the contour and act as impounding basins to pro-

mote further moisture absorption. These furrows may be used by themselves or in conjunction with a system of terraces. Detailed construction of these furrows will vary with soil type, slope, erosion, and other factors. In recent years machines have been devised that seed small grains, grasses, and legumes and throw up the furrow in one operation. This method of runoff control is suited chiefly to use on pasture lands on strongly rolling or hilly slopes.

Mechanical devices used in stabilizing the flow of water in natural channels and gullies include various types of permanent and temporary dams. Permanent dams are constructed of concrete reinforced with steel and of rock and concrete. Paved waterways and channels of similar materials may be needed in certain critical positions. Temporary dams are constructed of brush, wire, logs, straw, and loose rock in various combinations. Dams of this type are used primarily to stabilize gullies or other channels so that vegetation, either grasses or trees, may be established. As with other engineering structures, dams must be correctly planned and carefully constructed to be effective. Careful consideration of their cost as compared to their effectiveness and usefulness is necessary in order to determine their economic value and the feasibility of installation.

The control of erosion cannot be reduced to a simple formula, and in very few places will the application of one of the control measures by itself be effective. They should be used in combinations, the specific combinations varying from one part of the county to another, from farm to farm, and from field to field. In general they involve readjustments in land use and land management.

In some places erosion control can be accomplished largely through the efforts of the individual farmer but, in general, cooperative efforts of farmer, community, and county, aided and guided by various State and Federal agencies, are necessary to obtain the readjustments needed in the solution of the problems.

DRAINAGE

The term "drainage" refers to artificial removal of water from soils. A total of about 2½ percent of the soils in the county are affected to some degree by adverse drainage conditions. One-fifth of this, or about one-half of 1 percent of the county area, is so poorly drained that the soils are not suited to growing crops in their present condition but can be used for pasture. In this group are the Melvin, Dunning, and Atkins soils on the stream bottoms, chiefly in small areas; the Robertsville and Tyler soils in small depressed areas on old stream terraces; and the Guthrie soil in the bottoms of small lime sinks and depressions. The remaining acreage is so imperfectly drained that it can be used for growing only a limited number of kinds of crops, and tillage and cultivation are delayed and interrupted by unfavorable moisture conditions. Soils with this type of drainage constitute only about 2 percent of the total county area, but they include more than 12 percent of the crop-suited soils. The most important of these soils are those of the first-bottom lands, including those of the Philo and Lindsides series, and Alluvial soils, undifferentiated. Other soils are those of the Monongahela and Taft series on the low, nearly level stream terraces and the Ooletwah series in the bottoms of imperfectly drained lime

sinks and depressions. Most of these soils are in areas of moderate to large size.

Some attempt has been made to drain a large part of these soils, largely by means of shallow, open ditches. In very few places have these measures been adequate to improve soil moisture conditions materially, although some of the surplus surface water is diverted from the fields. Adequate drainage systems will be useful in improving conditions for plant growth in many places. On the poorly drained soils the kind and yields of pasture plants will be increased and in some places, chiefly on the Melvin soil, it may become possible to obtain profitable yields of corn and hay. On the imperfectly drained soils both the range of use suitability and yields can be increased. Furthermore, tillage operations can be more easily and more promptly accomplished at less cost if soil moisture conditions are improved.

Soil type, cost, and engineering problems are among the factors that determine the advisability of draining any particular area of soil and the type of drains needed. On certain soils, artificial drainage is difficult or impossible because of the physical properties of the soil, engineering problems, or both, whereas on others drainage can be improved with relative ease accompanied by a marked increase in the agricultural value of the soils.

In most places drainage of the Guthrie and Ooltewah soils is impractical inasmuch as they are in depressions and drainage outlets cannot be obtained. Drainage is difficult in many places on the Tyler, Robertsville, and Dunning soils for the same reason. In addition, the impervious nature of the subsoil in these series greatly restricts any movement of water, so that drains must be very closely spaced for best results. Inasmuch as these soils, with the exception of that of the Dunning series, are relatively low in inherent fertility, it appears that in many places, drainage even if feasible from the engineering standpoint, is uneconomical because of the low crop yields that can be obtained.

The physical properties of the Lindside, Melvin, Philo, and Atkins soils are such that they can be drained with comparative ease. In general, they are pervious to moisture and have no hardpan or cemented layers to interfere with water movement. Although no specific study of the engineering aspects of draining these soils has been made, it appears that there are no serious obstacles in this respect. It is believed that field drains constructed of unglazed tile are suitable for use on these soils. Open ditches for drain outlets are needed in many places. Depth, spacing, and fall of drains should be determined if possible by consulting a competent engineer or referring to reliable specifications or bulletins.

In general, the increases in yields and use suitability will more than offset the cost of drainage on all these soils with the possible exception of those of the Atkins series. The Atkins soils are relatively low in fertility, and even where drained, they may produce such low yields that drainage costs will not be repaid. On much of this soil, open ditches designed to remove excess surface water and improve grazing conditions are probably most suitable. Alluvial soils, undifferentiated, have such unfavorable properties, such as stoniness or low inherent fertility, that drainage is not advisable in many places, but

where other physical properties are good, the soil can be improved by artificial drainage.

Drainage of the Taft and Monongahela soils is at least moderately difficult because of the impervious nature of the subsoil and hardpan layers. No known serious engineering difficulties are involved in draining these soils, but the cost may be relatively high because of the power and labor required. The advisability of draining these soils varies from farm to farm. Where they are in broad areas and constitute a large part of the total acreage of a farm, it is likely that the cost of drains is justifiable, but where they are in small areas on farms that have relatively large areas of well-drained soils, drainage may not be profitable. In such places, the use of the soils in their natural condition for growing hay and pasture crops with corn interspersed at infrequent intervals is possibly advisable.

SOIL ASSOCIATIONS

A soil association may be defined from either of two points of view. It may be considered a group of soils occurring together in a characteristic pattern or a landscape definable as to the kind, proportion, and distribution of its component soils. In either case a soil association may consist of only a few or of many soils, which may all be similar or may represent many differing types. In each association, however, there is a certain uniformity of soil pattern.

The degree of uniformity within a given soil association depends largely on the scale of the map and the degree of detail followed in its preparation. Soil associations can be outlined so that they have a high degree of uniformity in pattern, but the maps showing these associations in most areas are rather detailed. Under such conditions, the definitions and descriptions of the associations can be made relatively specific.

Soil associations can also be outlined broadly on a map of small scale and thus have a low degree of uniformity. Choice of a level of uniformity or degree of detail in a soil association map should be based on the purpose for which the map is made. In any case the degree of uniformity obtainable depends upon the available sources of information. With a thorough knowledge of the individual soils and a detailed soil map, good maps can be prepared at a number of different levels of generalization. The importance of a thorough knowledge of the soils for preparation of a good soil association map cannot be overemphasized. The best one, regardless of the level of generalization, can be prepared by someone who knows the soils well and who has available a detailed soil map of the area.

The uses of soil association maps differ from those of detailed soil maps. For example, soil association maps cannot provide sufficient information for the study of individual farms or for the planning of farm operations. Like other simplified or generalized soil maps, they serve especially to give a picture of the soils of the larger region, as a community, a county, a State, or the Tennessee Valley. These maps are useful in regional studies of agricultural production or of changes and adjustment that may be necessary in such production.

Eleven soil associations have been recognized in Claiborne County. Two of these, the Muskingum-Jefferson-Philo and Rough stony land

are part of the physiographic region known as Cumberland Mountain. The others are in the Valley and Ridge province and lie in belts extending roughly northeast-southwest across the county. These associations are Talbott-Caylor-stony land; Stony land-Talbott-Caylor; Fullerton-Clarksville-Claiborne (hilly to steep); Fullerton-Claiborne-Clarksville (rolling to hilly); Armuchee-Lehew-Muskingum; Lehew; Montevallo-stony land-Leadvale; Monongahela-Leadvale-Jefferson; and Armuchee-stony land-Sequoia. All these associations tend to follow exposures of geologic formations. They are defined and described in the following pages in terms of the proportions and patterns of the different soils. The present and potential uses in agriculture of the areas are also discussed briefly.

MUSKINGUM-JEFFERSON-PHILO ASSOCIATION

The Muskingum-Jefferson-Philo association occupies 17.6 percent of the county on Cumberland Mountain in the northwestern part of the county and smaller irregular areas in the southeastern part. It is characterized by strong relief, ranging from several hundred to more than a thousand feet. Slopes are dominantly steep with small hilly areas in places. Stream valleys are narrow and have steep rocky walls. The streams have rather steep gradients, and geologic erosion is active. The rocks underlying the Cumberland Mountain area are chiefly level-bedded to gently folded massive acid sandstone and conglomerate with thin layers of silt, stone, and acid shale in places. Extensive deposits of bituminous coal are in the underlying formations. The other areas are underlain by strongly folded massive sandstone.

Muskingum soils and Rough stony land (Muskingum soil material) constitute 90 percent or more of the Cumberland Mountain area and practically all of the smaller areas in the southeastern part of the county. Both are very poorly suited to either crops or pasture. The Muskingum soils are in broad areas on the hilly and steep mountain slopes, whereas the Rough stony land (Muskingum soil material) is chiefly in narrow strips along stream gorges and on the crests of some of the mountains.

The rest of the association consists of Jefferson, Philo, Pope, Atkins, and Hartsells soils, Stony colluvium (Muskingum soil material), and Mine dumps. The Philo, Pope, and Atkins soils are in long narrow strips on the stream-bottom lands in a complex pattern, the acreage of the Philo soils being greatest. The Jefferson soils are in small areas on sloping benches bordering the stream valleys and in long narrow strips along some intermittent drainageways. The Hartsells soil is in small irregular-shaped areas on some of the broader, more level mountaintops. Stony colluvium is at the mouth of drainageways and in places bordering the channels of the larger streams. The total acreage of Mine dumps is small, but the areas are conspicuous on the landscape.

The Jefferson, Philo, and Pope soils are moderately low in productivity in their present condition, but they are rather easily conserved and worked and generally respond well to good management. They are fair to good cropland. The Atkins soil is so poorly drained that it is poorly suited to crops, but it is fair to good pasture land if properly managed. Stony colluvium (Muskingum soil material) and Mine

dumps are entirely unsuited to crops or pasture and may be considered as forest land or wasteland.

More than 90 percent of the association is under forest, chiefly on Muskingum soils and Rough stony land (Muskingum soil material). Small areas of the bottom lands and colluvial lands are in forest, especially in the unsettled regions away from the coal mining communities. Forest management is at a fairly high level, but it appears that the better classes of timber are being depleted more rapidly than they can reproduce.

Most of the farms are small and distributed chiefly along the narrow valleys that have at least small quantities of soils suited to crops or pasture. Corn, lespedeza, and vegetables for home consumption are the chief crops and are raised on the Hartsells, Pope, Philo, and Jefferson soils. Some pasture is on the Atkins soil and the less stony Muskingum soils. Most farms in the Cumberland Mountain area are part-time operated by coal miners, and their management is at a low level. Ordinarily, fertilizers or other soil amendments are not used, and no special methods for conserving soil material and moisture are practiced on the more rolling and hilly soils of the uplands. The productivity of the soils suited to crops and pasture of the area can be increased to a considerable extent by better selection and rotation of crops, use of lime, fertilizer, manure, and green-manure crops, and better control and use of the water on the land.

ROUGH STONY LAND ASSOCIATION

The Rough stony land association occupies 7.6 percent of the county in one large area on the Cumberland Mountain escarpment and adjacent mountain ridges and in a small area on Newman Ridge in the eastern part. Like the Muskingum-Jefferson-Philo association, it is underlain chiefly by acid sandstone and conglomerate. It differs, however, in that the rocks are generally sharply tilted rather than nearly level. Limestone and shale are also under part of the association on the lower slopes of the Cumberland Mountain escarpment, and the Newman Ridge area is entirely underlain by limestone. Slopes are steep to very steep, and outcrops of rock are characteristic as are large bluffs of sandstone and conglomerate, especially near the crest of the escarpment.

Rough stony land (Muskingum soil material) constitutes half or more of the total area of this association. It is chiefly on the upper escarpment slopes. Muskingum soil in small to medium-sized areas is mingled with the rough stony land in a complex pattern. Extensive areas of Limestone rockland (rough) are in many places in the lower mountain slopes and throughout the Newman Ridge area. Areas of Armuchee soils and Rough stony land (Talbot soil material) are also included in places on the lower slopes and outliers of the Cumberland escarpment. All the land types and soils included in this association except some of the Armuchee areas are very poorly suited to either crops or pasture and are properly considered forest lands.

At the present time, practically all of this association is under second-growth forest consisting chiefly of pines mixed with such hardwoods as post, red, and black oaks, black tupelo (blackgum), and sourwood. Most of the land is owned by one land company, but some small areas

may be included in farms centered in the adjacent limestone valley. Most of the better classes of timber have been harvested, the present stands consisting chiefly of young, cull, and weed trees.

Inasmuch as nearly all the soils and land types included in this association are entirely unsuited physically to use as cropland or pasture land they are limited to forest use, even though they are less productive of trees than are the soils in many other associations. Soil use and management are therefore concerned chiefly with the development and use of the forest resources.

TALBOTT-CAYLOR-STONY LAND ASSOCIATION

The Talbott-Caylor-stony land association occupies the southwestern two-thirds of Powell Valley and includes 4.3 percent of the county. It lies on rolling valley land below the precipitous Cumberland escarpment along the northwestern edge and the hilly to steep cherty ridge lands of the Fullerton-Clarksville-Claiborne (hilly to steep) association along the southeastern edge. The conformation, or lay of the land, is irregular because of the many shallow sinks and the shallow valleys of small streams that cross Powell Valley from Cumberland Mountain. The entire association area is underlain by relatively high-grade limestone, and many of the soils are derived from residuum weathered from these rocks, although there are extensive areas of colluvium and stream alluvium from which many of the more productive soils are derived.

The soil pattern of this association is complex. Talbott, Caylor, and stony land (Talbott soil material) are the most extensive but there are notable acreages of the Armuchee, Allen, and Jefferson soils. The Talbott, Caylor, and stony land types are distributed throughout the central parts of the area, whereas the Allen and Jefferson types are on somewhat higher lying colluvial foot slopes near the Cumberland escarpment. Most of the Armuchee soils are directly adjacent to the escarpment on strong slopes. There are some areas of Dewey soils intermingled with the Talbott, Caylor, and stony land types; and Monongahela, Ooltewah, Guthrie, Lindside, Melvin, Dunning, and Sequatchie soils are on the alluvium in depressions, sinks, and the low-lying stream terraces and first bottoms.

Practically all the soils included in this association are suited to farming purposes, estimates showing that about 70 percent of the association is suited to crops requiring tillage and practically all the rest at least to pasture. All the Talbott, Caylor, Dewey, Allen, Jefferson, Etowah, Monongahela, Taft, Sequatchie, Ooltewah, and Lindside soils are fair to excellent croplands; whereas the Talbott and Dewey soils on hilly and steep slopes, the stony land types, the Talbott-Hayter complex, and the Armuchee, Robertsville, Guthrie, Melvin, and Dunning soils are fair to good pasture lands, although not well suited to crops requiring tillage.

This association supports one of the most prosperous agricultural communities in the county. Most of the farms are medium size with considerable diversity of enterprises and are classified as general farms. Corn, lespedeza, wheat, and burley tobacco are the chief crops on most farms. Minor crops include red clover, alfalfa, soybeans, cowpeas, oats, barley, and fruits and vegetables for home consumption. Small

herds of beef cattle are on many farms and poultry, hogs, and dairy cows to furnish dairy and poultry products and meat for home consumption are on practically all farms.

Present land use is fairly well adjusted to the physical suitability of the soils in the association, but management is not generally at a level that will maintain or increase the productivity of the soils. A large part of the soil is cleared and used for crops and pasture, but small areas of woodland are on most farms, chiefly on the stonier and more strongly sloping uplands and on poorly drained bottom lands. Among the improved management practices needed on most farms are better selection and rotation of crops, use of more lime and commercial fertilizer, and better control and utilization of water on the land. Most pastures can be improved by the use of more amendments, better control of grazing, and improvement of composition of pasture mixtures by eradicating weeds, and seeding with the higher yielding, more nutritious grasses and legumes.

STONY LAND-TALBOTT-CAYLOR ASSOCIATION

The Stony land-Talbott-Caylor, occupying 9 percent of the county, is one of the more extensive associations and is widely distributed. It occupies smooth to rolling limestone valleys. The chief areas are (1) northeast of Powell Valley, (2) in Cedar Fork Valley from the vicinity of Tazewell northeast to the Hancock County line, and (3) in the valley of Little Sycamore Creek. The nature of this association differs from the Talbott-Caylor-Stony land chiefly in consisting largely of Smooth stony land (Talbott soil material) and in having only a minor acreage of Talbott and Caylor soils. In some places, especially in Cedar Fork Valley, there are several areas of Dewey and Hayter soils, but they are not large, and like the Talbott soils, are associated with the predominant stony land types. Lindside and Melvin soils are in narrow strips along the larger streams, and there are small areas of limestone rockland intermixed with the stony land types.

Approximately 90 percent of this association is suited to agricultural use, but at least two-thirds of this is not well suited to crops; its use being limited chiefly to pasture because of its stony nature. The acreage of soils well suited to crops is chiefly of the Talbott, Caylor, and Dewey series.

Raising beef cattle is the chief enterprise on many farms. Most farms, however, have sufficient diversity to permit their classification as general farms. Corn, hay, and pasture for livestock feed are the chief crops, although burley tobacco is an important cash crop. Fruits and vegetables for home use and wheat are other common crops. Most farms are fairly large, consisting of a relatively large acreage of soils suited only to pasture and a small to moderate acreage suited to crops. There are a few minor subsistence type farms.

Land use is generally well adjusted to the suitability of the soils. Soil management, however, is considerably below the level that is considered feasible for the present agriculture. The use of lime and fertilizer, the control of grazing, and the clipping of weeds are among the more important requirements of good pasture management. Management requirements for the production of crops on the soils suited to

tillage include a moderately long systematic rotation, use of lime and adequate fertilization, growing winter cover crops, and better control of runoff water.

FULLERTON-CLARKSVILLE-CLAIBORNE (HILLY TO STEEP) ASSOCIATION

The Fullerton-Clarksville-Claiborne (hilly to steep) association, occupying 40.6 percent of the county, is characterized by a hilly to steep surface and represents the extensive rougher part of the cherty ridge areas (pl. 13, *A*). Fullerton and Clarksville soils predominate, but in many places Claiborne soils occupy a considerable part of the landscape. A small acreage of Bolton soils is widely distributed, and small areas of Greendale, Roane, and Lindside are in depressions and along drainageways. Most ridge crests are occupied by narrow irregular strips of smooth to rolling Fullerton and Claiborne soils. The largest area is a broad irregular belt along the Powell River. The second largest area, ranging from 1 to 1½ miles in width, stretches across the county in a northeast-southwest direction roughly between Wallen Ridge on the northwest and Powell and Lone Mountains on the southeast. The third and smallest area is along the Clinch River in the southeastern part of the county.

Chiefly because of the predominantly steep slope and the relatively low fertility of most of the soils, this association is of relatively low agricultural productivity. Probably 70 percent is poorly suited to either crops or pasture and only about 15 percent is considered physically suitable for crops requiring tillage. A large part of this area is in hardwood forest, and the cleared and cultivated areas are confined chiefly to the smoother parts on the narrow irregular ridge tops.

Many of the farms are of the subsistence type (pl. 13, *B*); they vary considerably in size but most of them include too small areas of soils suited to crops and pasture to be classed as general type farms. Vegetables and fruits for home consumption, burley tobacco, and hay and wheat are the more important crops. One or two dairy cows, a few pigs, and small flocks of chickens are the chief livestock. Present land use is fairly well adjusted to the physical use suitability, although not ideally so, as many small areas of steep and eroded soils are used for crops or pasture that should be used less intensively. Soil management is not at a high level. Readjustment needed to obtain optimum production involves better selection and rotation of crops, the use of lime and more adequate fertilization, and more effective control of runoff.

FULLERTON-CLAIBORNE-CLARKSVILLE (ROLLING TO HILLY) ASSOCIATION

The Fullerton-Claiborne-Clarksville (rolling to hilly) association represents the smoother parts of the cherty ridge areas. It occupies 11.9 percent of the area of the county. The surface is rolling to hilly and surface drainage is generally to sinkholes. Fullerton and Claiborne soils are more predominant over the Clarksville soils than they are in the Fullerton-Clarksville-Claiborne (hilly to steep) association. Bolton soils are common in places, and the proportion of Greendale

soils is greater. A large part of this association lies as one body in the central part of the county, with a few small irregular areas distributed throughout the northeastern part. All the areas are largely surrounded and somewhat dissected by the steeper Fullerton-Clarksville-Claiborne association.

This association represents some of the better agricultural areas of the county. About 90 percent of it is suited to pasture, over half of which is fair to very good cropland.

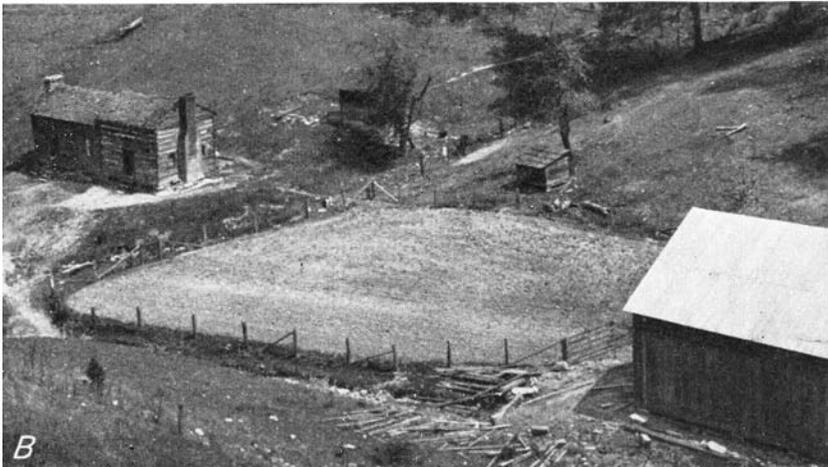
Farms on this association are chiefly of the small general type, although there are also many subsistence farms. Farm income is derived from the sale of tobacco and other field crops and a few hogs and cattle. Tobacco, corn, wheat, and hay are the chief field crops. Live-stock enterprises on most farms include small numbers of hogs, small to medium-sized flocks of chickens, a few dairy cows, and in many places a few beef cattle. Farms are small to medium size and generally include a complex pattern of soils suited to crops, pasture, and forest. Land use and management are fairly well adjusted to the physical suitability of the soils. The use of lime and larger quantities of commercial fertilizer are needed to obtain the best yields of crops and pasture. Rotation of crops and better utilization of soil moisture are other practices needed on croplands. Many small areas of steep, cherty, and stony soils now cleared and in pasture or crops could well be abandoned to forest, if greater intensity of management were applied to the soils better suited physically to crops and pasture.

ARMUCHEE-LEHEW-MUSKINGUM ASSOCIATION

Almost all the areas of the Armuchee-Lehew-Muskingum association lie as long narrow strips occupying steep mountain slopes. The aggregate area is 3.2 percent of the county. Armuchee soils are on the lower part of the slopes and represent at least half the acreage and much of this has a steep slope, although some parts have a gradient of less than 30 percent. Lehew soils occupy a large part of the remaining acreage and are on the steep upper parts of the slopes and the narrow ridge crests. Muskingum soils are on some of the steep slopes of the Wallen Ridge area. Here, the Muskingum soils predominate over the Lehew soils, but in the other two large areas, Lone Mountain and the northwest slope of Powell Mountain, there is very little Muskingum soil.

Very little of this association is suitable for crops requiring tillage, but the greater part of the Armuchee acreage affords fair to good pasture under proper management. Most of the Lehew and Muskingum soils are not well suited to either crops or pasture. At present most of the Lehew and Muskingum soils are in cut-over forest, but much of the Armuchee soils is cleared and used for pasture and crops, pasture use predominating. Practically no farmsteads are on this association, but a great part of the Armuchee soils are adjacent to the Stony land-Talbott-Caylor association and are a part of farms having their crop acreage and buildings on this latter association.

Land use and management can be improved on much of the Armuchee soils. In general they should not be cultivated, and permanent pasture on them can be improved by fertilization, especially with



A, Strong slopes, irregular fields, and much woodland characterize the Fullerton-Clarksville-Claiborne (hilly to steep) association.
B, Farmstead on the Fullerton-Clarksville-Claiborne (hilly to steep) association. Fenced garden is on Greendale soils. Paths from house lead to corn, tobacco, and hay on cherty Clarksville and Fullerton soils on rolling ridge tops and to pasture on higher slopes.



A, Cumberland Mountain, with Fern Lake, which is formed by a dam on Little Yellow Creek. This area is poorly suited to agriculture but has important coal and timber resources.
B, Tram hauling logs from the Tackett Creek watershed in Cumberland Mountain.

phosphorus, liming, and eradication of weedy growth. In general, the Lehew and Muskingum soils should remain in forest.

LEHEW ASSOCIATION

The Lehew association consists very largely of steep soils that are shallow to bedrock shale and low in fertility. The aggregate area is 2.9 percent of the county. The greater part lies as an irregular belt adjacent to the valley of Big Sycamore Creek. Lehew soils predominate, but there are some Montevallo and Armuchee soils along the arm of Norris Reservoir in the valley of Big Sycamore Creek and some Leadvale lying as narrow strips along a few of the drainageways.

Very little of this association is suited to either crops or pasture except the small amount of Armuchee soils that is fair to good pasture land and the small acreage of Leadvale soils. There are few if any farmsteads, but some areas are cleared along the drainageways and farmed in conjunction with fields in adjoining associations that are better suited to crops and pasture. Cut-over forest occupies a large part of the aggregate area and in general is probably the best use for this land.

MONTEVALLO-STONY LAND-LEADVALE ASSOCIATION

The Montevallo-stony land-Leadvale association consists of shaly valley areas that have a predominantly hilly to steep surface. The aggregate area is 1.4 percent of the county, and all of it is in Caney Valley and the valley of Big Sycamore Creek. Most of the soils are shallow to bedrock and of low to medium fertility. Hilly and steep Montevallo soils occupy 40 to 45 percent of the area and hilly and steep Armuchee soils and stony land types (Talbot soil material) 40 to 45 percent. The remaining 15 percent consists chiefly of Leadvale, Pope, and Philo soils.

The percentage of land suitable for crops requiring tillage varies notably from place to place but in general it is low. About 35 percent of the area in the valley of Big Sycamore Creek is physically suited to crops but only about 15 percent of the area in Caney Valley is suited to this use. A little less than half the remaining acreage is physically suited to pasture and the rest is suited only to forest.

From 45 to 60 percent of the area is cleared. This includes practically all the Leadvale, Pope, and Philo soils and in general much of the less steep stony land types, Montevallo, and Armuchee soils. A considerable part of strongly sloping to steep Montevallo and Armuchee soils has been cultivated that is poorly suited to this use.

Farms on this association are almost entirely of the subsistence type, a large part of the farm produce being consumed by the family. A small cash income is obtained from the sale of tobacco. Tobacco, corn, and lespedeza are the chief field crops, but vegetables and fruits for home consumption are important. Livestock consists of a small flock of poultry, one or two hogs, and a dairy cow per farm. The size of farms ranges from small to large, but the acreage of crops and pasture on all of them is small. Soil uses and management are very poorly adjusted to the physical properties of the soils. Soil erosion is more conspicuous and widespread than on any other association largely

because broad areas of shallow soils on hilly and steep slopes have been cleared and used for crops and pasture. Under the low level of management practiced on these soils, the low natural fertility was soon exhausted and large areas on Montevallo and Armuchee soils are now idle or abandoned. Very little of these upland soils can be feasibly used for crops and only under a high level of management can the more favorable parts be used feasibly for pasture. A large part is best suited only to forest. Proper fertilization, liming, and weed control are needed for pasture improvement, and in general improved fertilization, liming, crop rotation, and in places water control methods are needed on the soils of the bottom lands and colluvial slopes to bring them to optimum production.

MONONGAHELA-LEADVALE-JEFFERSON ASSOCIATION

The Monongahela-Leadvale-Jefferson association is in one medium-sized area in the southeastern part of the county and includes 1.1 percent of it. It consists of the northern half of the valley of Big Sycamore Creek and is a nearly level to gently rolling alluvial-colluvial basin broken in places by small knobs and spurs of uplands. It is underlain chiefly by acid shales, but the soils are derived almost entirely from alluvium and local alluvium washed chiefly from acid shale and sandstone.

The Monongahela and Leadvale soils are in broad areas on nearly level to gently sloping stream terraces and colluvial benches, respectively; and many small areas of Jefferson soils are on the more rolling colluvial benches near the foot of mountain slopes. Philo soils are in fairly large areas along the stream bottom lands and small areas of Tyler soil are on some of the stream terraces. Areas of Allen soil are on strongly rolling colluvial lands at the base of Skaggs Ridge near Howard Quarter School and near the base of Newman Ridge. Many small areas of Montevallo soils are on small hilly and steep isolated knobs in the valley proper and in places along its edges at the base of some of the higher ridges. Much of this association is suited to growing either crops or pasture.

Most farms on this association are of the small general type, but some are subsistence farms. Burley tobacco, corn, and hay are the chief crops. Beef cattle are the principal class of livestock, but one or two dairy cows, medium-sized poultry flocks, and a few hogs are kept on most farms. Farms are small to moderate in size and consist largely of soils suited to crops, although many extend into the Muskingum-Jefferson-Philo, the Lehw, and the Rough stony land associations, which consist almost wholly of soils very poorly suited either to crops or pasture. Soil use is fairly well adjusted to the physical suitability of the soils, but management is considerably below the highest possible level. Improvement of moisture conditions through artificial drainage is needed in many places. Use of lime and fertilizer and better choice and rotation of crops are required to obtain optimum production on most of these soils.

ARMUCHEE-STONY LAND-SEQUOIA ASSOCIATION

The Armuchee-stony land-Sequoia association is in one small area in the south-central part of the county and includes 0.4 percent of

its area. It consists of a small smooth valley and a belt of hilly and steep ridges on either side. The underlying rocks are chiefly interbedded limestone and shale, and most of the soils are derived from residuum weathered from these rocks.

The Armuchee soils, the stony land types, and the Sequoia soil constitute the principal part of the association, the Sequoia soil being on the low rolling uplands on the valley floor and the Armuchee soils and the stony land types on the hilly and steep adjacent slopes. Soils of smaller acreage include Leadvale, Dewey, and Philo soils. About half the acreage is suited to crops requiring tillage, and most of the rest is suited to pasture. The soils suited to crops are confined to the smooth valley part, and much of those suited to pasture are on the adjacent hilly and steep slopes. Some of these steeper soils are poorly suited to either crops or pasture and are best used for forestry purposes.

Most of the few farms on this association are of the small general or subsistence types. Corn, tobacco, and hay are the chief crops and hogs, poultry, and a few dairy cows the chief livestock enterprises. Soil uses are fairly well adjusted to their physical use suitability, but management practices are at a fairly low level. Use of more soil amendments and better control and utilization of water on the land are needed on both cropland and pasture land. Better selection and rotation of crops will help to increase the productivity of the croplands.

GENERAL DISTRIBUTION OF LAND CLASSES

In the section on Land Classification the soils are placed in five land classes and the basis for placing them in these groups is there described. Figure 2 is a generalized interpretative map showing the distribution of six groups of soils, each group defined in terms of percentages of the five land classes. This map is designed to show the general use capability of broad areas in terms of combinations of the five land classes. This is not a grouping on which recommendations for land use and management of individual farms can be based. Neither can it be used to determine the productivity of a particular farm.

Group 1 has the greatest capability for the production of crops requiring tillage. Approximately 70 percent of it is physically suitable for this use, and more than half of this is good to excellent cropland. A large part of the remaining acreage is suitable for pasture. Group 2 consists largely of soils physically suited to crops, but much of it is rated as only fair for this use. Nearly half of the acreage of group 3 is physically suited to crops requiring tillage and most of the remaining part is suitable for pasture. About 75 percent of group 4 is poorly suited to crops requiring tillage, but much of it is suitable for pasture. The part suited to crops is fair to good for that purpose. Group 5 has only a small part suited to crops and much of the remaining part is suited only to forest. Practically all of group 6 is poorly suited to either crops or pasture.

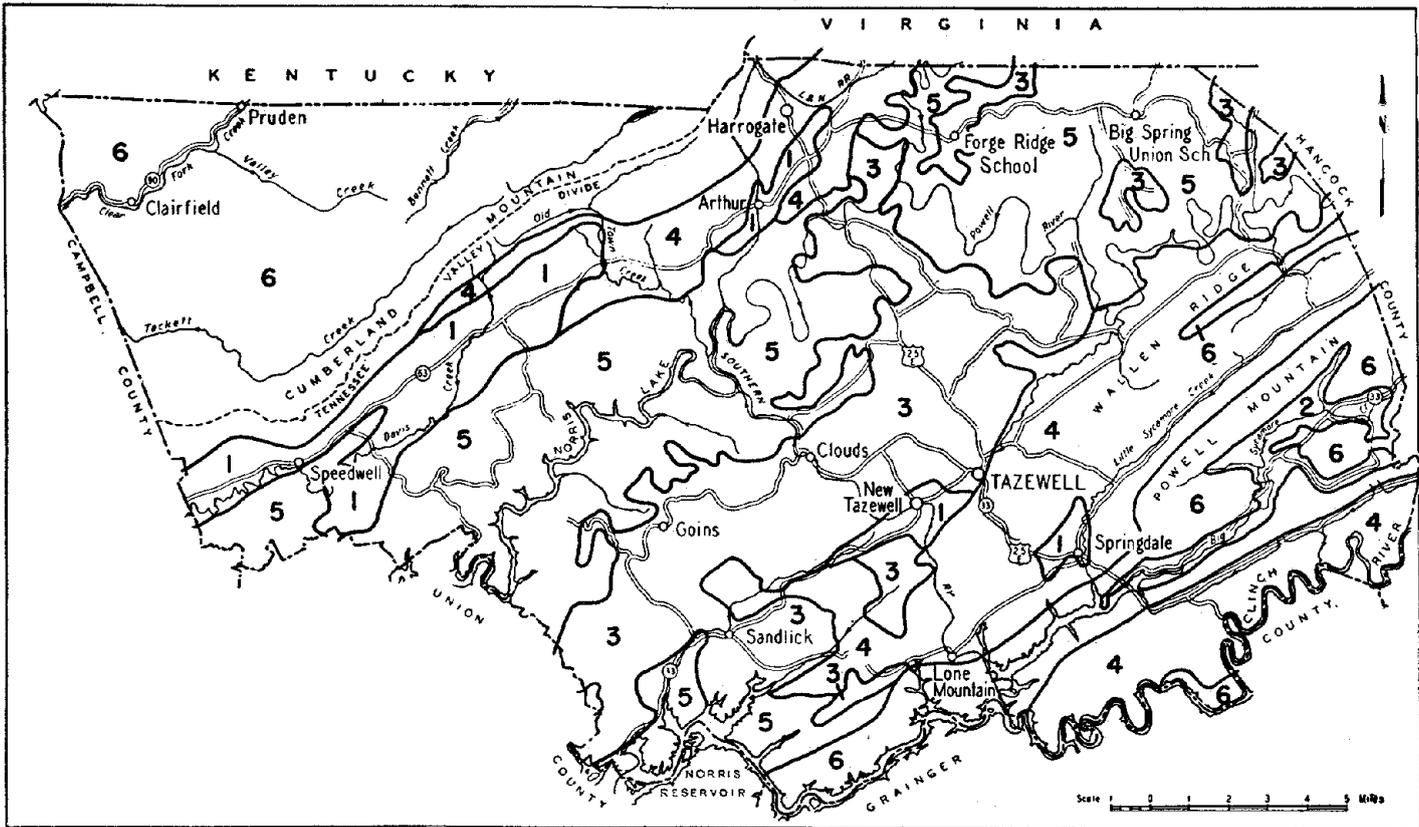


FIGURE 2.—Legend on facing page.

FORESTS ⁹

A century of lumbering activity, which reached its peak around 1900, removed practically all the old-growth timber from the forests of Claiborne County, and the present forests consist almost entirely of second-growth timber. Estimates indicate that about 160,000 acres is in forest. According to the 1940 census 47,527 acres of this woodland is included in the 171,246 acres of land in farms. The rest is owned largely in large tracts by corporations and individuals. Forests and woodlands are in all parts of the county, but not uniformly distributed. They are most extensive on areas consisting largely of Fifth-class soils, but all Fifth-class soils are not in forests and all forests are not on Fifth-class soils.

The most important forested area in the county, both from the standpoint of total area and yield of forest products, is the Cumberland Mountain section (pl. 14, A). Nearly all the land in this area is too steep and too stony for agricultural use, and it is almost entirely covered by forests of the hardwood type. A mixture of tuliptree (yellowpoplar); basswood; cucumbertree; dead chestnut; chestnut, white, black, Northern red, and scarlet oaks; blackgum; hickory; and small numbers of numerous other trees are on the Muskingum soils. Along the narrow stream bottom lands on the Jefferson and Philo soils and on the lower, more moist mountain slopes on the Muskingum soils are large numbers of hemlock, with beech, sugar maple, walnut, and cherry in some of the more favorable sites. In most places, a heavy undergrowth of mountain-laurel, rhododendron, and holly is on these stream bottom lands. On the steeper mountain slopes and on crests of Rough stony land (Muskingum soil material) the forests are of poorer quality, consisting of Virginia pine and various hardwoods, including post oak, persimmon, red maple, sycamore, and some hickory. Although nearly all of this area has been logged, the quality of timber is generally higher than in other parts of the county. Selective cut-

⁹ Prepared by G. B. Shivery, extension forester, University of Tennessee.

EXPLANATION OF FIGURE 2

General distribution of six soil groups in terms of percentages of the five land classes in Claiborne County, Tenn.—Approximate percentage of each area in the five land classes

Group	Soils physically suited to crops requiring tillage			Soils not physically suited to crops requiring tillage	
	First class	Second class	Third class	Fourth class	Fifth class
	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
1 -----	5	35	30	25	5
2 -----	0	15	65	5	15
3 -----	0	15	35	40	10
4 -----	0	10	15	45	30
5 -----	0	5	10	25	60
6 -----	0	0	5	5	90

ting is practiced, and all timber under 16 inches in diameter is reserved, so that a continued crop is assured.¹⁰

In the Great Valley section of the county, the forests are chiefly on the hilly and steep ridge lands. The crests and southeast-facing slopes of Powell Mountain, Wallen Ridge, and Lone Mountain and the northwest-facing slopes of Poor Valley Ridge are entirely covered with forests, except for a few small widely separated clearings. The soils on these mountain slopes are those of the Muskingum series. The forests are chiefly hardwoods, including various kinds of oak, hickory, blackgum, tuliptree, and some basswood. Shortleaf pine is on some of the more rocky and droughty sites. In most places these forests have been cut-over several times, and the present stand of timber consists largely of immature or cull trees.

Except for small areas along the lower slopes, all of Comby Ridge and Sycamore Knobs are in cut-over forests. The soils on these ridges are of the Lehigh series. The forests are a mixture of pine and hardwoods and include post, blackjack, and some red oaks, blackgum, sourwood, and shortleaf pine. Nearly pure stands of shortleaf pine are on some of the poorer sites. All this area has been logged, and at present there is very little merchantable timber.

Most of the Montevallo soils on the shale knobs of Caney Ridge were cleared and used for cropland at some time in the past, but at least half this area has been abandoned and is now covered with second-growth forest, chiefly shortleaf and Virginia pines. In the few places where the land was never completely cleared, some hardwoods are in the timber stand. In general, these forests are of poor quality, and the present harvest of forest products is small in quantity and of poor quality.

Probably half or more of the cherty-ridge sections of the county are in forests, partly in relatively small areas in farm woodland—but in many places in large tracts. Most of these forests are on hilly and steep phases of Clarksville and Fullerton soils and on Rough stony land (Talbot soil material), but some are on the more cherty rolling ridge tops and on Bolton and Claiborne soils on hilly and steep slopes. On the Fullerton soils the forests are dominantly hardwoods, including oak, hickory, dogwood, tuliptree, and blackgum, but on the loam types shortleaf pine is intermixed. The forests on the Clarksville soils are generally of poorer quality and consist of hickory, oak, and dogwood, with relatively large proportions of such weed trees as sourwood, blackgum, and persimmon in many places.

On the poorer, more droughty sites and on old abandoned fields, shortleaf pine is the principal tree. On the Bolton and Claiborne soils, the forests are chiefly hardwoods and contain a large part of beech, hard maple, and tuliptree in addition to oak and hickory. The second-growth forest on abandoned areas of these soils is largely a pine-tuliptree mixture.

The forests on Rough stony land (Talbot soil material) are chiefly hardwoods of poor quality with some scrubby pine on the drier sites. The rough rockland (limestone material) along the steep, rocky river bluffs of the area is nearly devoid of vegetation in most places; but

¹⁰ Information obtained by interviews with landowners and by field observation by members of the soil survey party.

small cedar and scrubby pine are in some of the more favorable sites. The forests in this area are variable in quality, but, in general, they have been seriously depleted by severe cutting and forest fires. The present yields of forest products are low as compared with the potentiality of the area.

The forests in the limestone valleys are in small tracts throughout the valleys and occupy a relatively small proportion of the total area. A notable exception is in Cedar Fork Valley where there is a large acreage of cedar forests. They are generally on Rolling stony land (Talbot soil material) and on Limestone rockland (rolling), but small areas also are on Armuchee soils and hilly and steep Talbot soils. The chief trees on the stony land and rockland types are redcedar with small numbers of oak and other hardwoods in places. Locust thickets are the chief growth on the Armuchee and Talbot soils, although widely spaced black walnut trees with timber value are on the pasture fields on these soils throughout the valleys. All the high-quality timber has been cut in these valley areas, and the present stands are chiefly the cull and weed trees. Practically no timber is harvested except for local use in building fences and for firewood.

Forest surveys (10) indicate that the present forests in the valley section of the county are of relatively low quality; and under present management systems they are being further depleted. Approximately one-fourth of all living trees are classed as either sound culls or rotten culls. The average stand of sawtimber to the acre is only 1,900 board feet. Two-thirds of the sawtimber volume is classified as medium and low grade from the industrial and economic standpoint. In addition to the sawtimber, there is in living trees, exclusive of the cull material, an average of 4.3 standard cords to the acre. This small material, not of sawtimber size or quality, is suitable for use as pulpwood, distillation wood, extract wood, fence posts, bobbin and shuttle material, and fuel wood. The average annual growth, including all live sound trees other than weed species and chestnut, is 49 board feet plus 0.12 standard cord in trees below sawlog size. This annual growth exceeds the annual drain in harvested timber, but a true analysis shows a depleted growing stock. Too small a part of the annual growth is high-grade timber, and too large a part is either so small that it is unmerchantable or is of low-grade trees suitable only for low-priced products.

The present use and management of forests vary from one part of the county to another and with the needs and interests of the individual landowners. In general the highest level of forest management is in the Cumberland Mountain section.¹¹ This large area of nearly 50,000 acres of mineral and forest land is owned almost entirely by one corporation. Fire damage in this area is relatively low, because careful measures for preventing and controlling fires are practiced. All trees of less than 16 inches in diameter at breast height are reserved, so that a continued supply of high-quality timber will be assured. Much wood, however, is wasted inasmuch as tops and defective materials are allowed to rot, chiefly because these lower grade materials cannot be profitably marketed under present conditions.

¹¹ See footnote 10, p. 206.

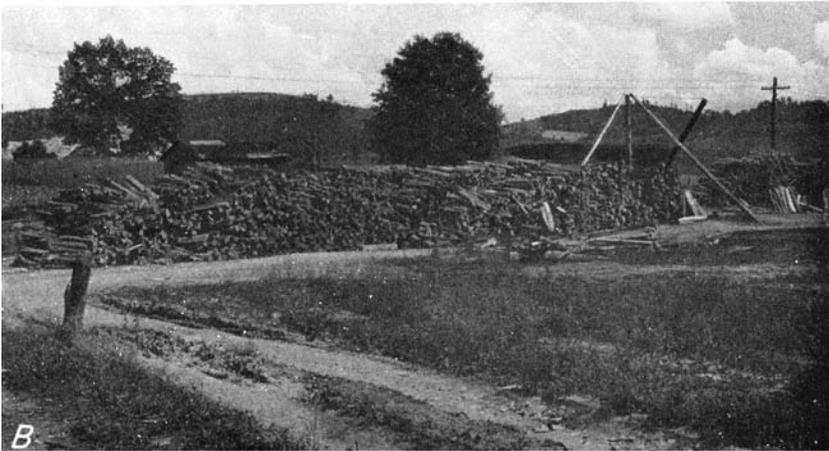
Logging operations are carried on chiefly with tractors over much of the area. Most of the timber is hauled from the mountains on a logging railroad (pl. 14, *B*) to the village of Duff in Campbell County, where it is sawed into lumber, bridge timbers, railroad cross ties, and building timbers at a large band-saw mill. In the northwestern part of the area the logs are hauled by team or truck to small portable sawmills, where they are manufactured into lumber and cross ties. Some of the low-grade material is used for mine timbers. Dead chestnut is harvested for extract and pulpwood.

The low yields and poor quality of the timber of the valley section of the county are the direct results of poor use and management of the forest resources of the area (10) (pl. 15, *A*). The two most damaging factors have been overcutting and recurrent fires. Many forest tracts are subject to annual fires caused by incendiaries, debris burners, and careless smokers. These forest fires prevent satisfactory natural reproduction of forests, inasmuch as seedlings and stump sprouts are destroyed. Large living trees are also damaged. Estimates indicate that roughly half the defective material in sound trees is caused by fires, and they are responsible for the fact that nearly a fourth of all living trees are either sound or rotten culls. Fires also impair moisture conditions by destroying the forest litter, which is very effective in absorbing rainfall, thereby decreasing the loss of water in runoff.

The chief timber products of the valley section are rough lumber and railroad ties, but small quantities of other materials are sawed in small portable mills in all parts of the county. The timber is cut closely and many logs are from trees of less than 10 inches in diameter. High stumps are left, and all the tops are left in the woods to rot. Manufacturing methods are wasteful, and estimates indicate that nearly half the volume of logs is lost in waste.

Lumber is sold in local markets and railroad ties to nearby railroads. Some of the better white oak timber is cut into stave and heading stock for the manufacture of tight barrels. Some pulpwood is shipped from the county to nearby manufacturers. Tuliptree and some pine are the chief trees utilized for this purpose, and many trees of as small as 6 inches in diameter are harvested. Dead chestnut is cut and marketed as extract wood (pl. 15, *B*). Other forest products, manufactured chiefly for home use, include hand-rived shingles, fence posts, and tobacco sticks. Much timber is utilized as fuel wood by the farm households. Although the combined value of all these products is relatively small, they are important to the agriculture and economy of the county, inasmuch as timber owners receive income from the sale of the products, and provide employment for a part of the farm population and livestock during the seasons of slack work on the farms.

Although these practices are generally prevalent in the valley section, some improvement in forest management has been effected in recent years through the cooperation of various public agencies. The State forest service, the Tennessee Valley Authority, and the Civilian Conservation Corps have cooperated in building fire towers and telephone lines and in organizing crews for fire detection and suppression. These measures have not attained a major degree of success, largely because of the lack of cooperation on the part of the people of the county. The Tennessee Valley Authority, with control of runoff as



- A*, Typical logging operation in the cherty ridge section. Logs are small, and waste material great. Timber on steep slope in background has been cut very close.
- B*, Acid wood of dead chestnut stacked at a railroad yard at Arthur. Although blight has killed all the chestnut trees, their acid wood and pulpwood is an important source of income.



A, Exposure of the relatively high-grade limestone from which parent material of the Talbott soils is weathered.
B, Area of stony land formerly covered by Sequoia soil, which was removed by severe accelerated erosion. Such severe erosion is rarely found in Claiborne County.

its chief objective, has been active in reforesting worn-out, eroded, and abandoned lands, both on private lands and on lands owned by the Authority.

From 1934 to 1940, using the personnel of the Civilian Conservation Corps, 3,532,000 trees were planted on 3,642 of the 21,505 acres¹² above the 1,020-foot contour in the Norris Reservation. In addition 1,939,000 trees were planted on 845 acres of privately owned land from 1934 to 1937, inclusive.¹³ Most of these plantings are on areas of 2 to 5 acres each. Inasmuch as the Civilian Conservation Corps is no longer engaged in planting on private lands, the Forestry Relations Department of the Tennessee Valley Authority in cooperation with the county agricultural agent supplies tree seedlings to landowners for controlling runoff. These trees are furnished free of charge, but the farmer is required to make certain essential land preparation, such as breaking and mulching eroded areas, building low-brush check dams, and plowing contour furrows in advance of the actual time that the trees are set. This type of planting increased from 3 projects totaling 5½ acres in 1939 to 18 projects including 29 acres in 1940.

The use and management of the forests of Claiborne County consist largely in the use and management of the Fifth-class soils. These soils have so many unfavorable physical properties that they are ordinarily unsuited to use as either cropland or pasture land. They are, therefore, by the process of elimination limited to forest use. At the present time a large part of these Fifth-class soils is in forest, and, in general, the part now cleared should be reforested, although the pressure of economic conditions may necessitate the continued use of some of these lands for crop or pasture purposes.

On most of these lands the forests are utilized chiefly for the production of timber, but the areas along the Norris Reservoir serve a dual purpose in that they are also useful in controlling runoff and preventing flooding and silting of the reservoir. Some of these lands also offer possibilities as game refuges and hunting and camping sites. It is possible that where these soils are in large continuous areas, they cannot be properly utilized and managed under small private ownership and ownership in large tracts by either private or public agencies may be advisable. In general, it appears that such ownership will permit the maximum development of much of this land for forestry, recreation, and flood control.

The poor management of the forests of Claiborne County in past years has led to nearly complete exhaustion of all the first-class timber, but under good management both the quantity and quality of the timber resources can be greatly improved. Efforts for better management should be directed toward the correction of the following three outstanding deficiencies: (1) The stands contain a high percentage of defective and unmerchantable trees, (2) the number of sound trees to the acre is too small, and (3) the proportion of large trees in the timber stand is too low. The means of accomplishing forest improvement will vary from place to place and among the different kinds of ownership. Economic and social problems as well

¹² Data from the Land Acquisition, Tennessee Valley Authority, Knoxville, Tenn.

¹³ Planting records, Watershed Protection Division, Forestry Relations Department, Tennessee Valley Authority, Knoxville, Tenn.

as purely forestry management are concerned. Specific recommendations for the management of any particular area or type of forest are beyond the scope of this report, but certain broad principles can be outlined.

Inasmuch as fires are responsible for much of the defective material in the forest of Claiborne County, fire protection is probably the most important single step that can be taken for forest improvement. Public agencies have provided equipment and personnel that should be largely effective in controlling forest fires, but they cannot be completely effective without the cooperation of individual farmers and communities. The practice of burning woodlands in spring to obtain a small quantity of grazing should be discontinued. These fires destroy young trees that are needed to insure reproduction of the forest stand and damage the large trees so that a lower quality of timber is obtained. They also destroy the layer of forest duff or litter, thereby greatly increasing the rate and quantity of runoff, causing poorer moisture conditions for forest growth and increasing erosion on the forest lands themselves and on adjoining cleared lands. Grazing of forest lands by livestock has effects similar to burning but less severe. The grazing animals destroy small seedling trees, acorns, nuts, and other tree seeds. Trampling the surface soils probably decreases their water-absorbing properties and increases the rate and quantity of runoff, thereby lessening the supply of moisture for plant growth and increasing erosion. The damage to forests by grazing outweighs by far the small quantity of low-quality pasture obtained.

Next to fire protection the most effective means of improving the forests of the county is through proper selection of trees to be harvested. On farms, a definite effort should be made to utilize defective material, such as trees injured by forest fires, disease, insects, logging damage, and wind and sleet storms. Tannic acid wood, distillation wood, pulpwood, posts, and mine timbers are commercial products that can be obtained largely from these defective and weed trees. Efforts should be directed toward expanding the markets for these low-grade materials so that the space occupied by weed and cull trees can be made available for sound, straight trees of the more valuable species. Selective cutting of the trees suitable for lumber and other high-grade uses should be practiced. Only large mature trees should be harvested, those of smaller size being left to grow to higher quality material.

There is a need for a definite program of reforestation on certain worn-out and abandoned lands and those inherently unproductive soils that have been mistakenly cleared and used for crops and pastures. Wherever possible, restocking by natural means should be encouraged. When protected from fires and grazing, blank and thin spaces in existing forests will soon be reforested by seeding from the trees nearby. Where cleared lands are to be reforested, some soil preparation is needed to insure success. Gullies should be stabilized by suitable check dams. Contour furrows will be effective in conserving soil moisture and preventing erosion. Mulching with straw or other refuse materials is helpful on severely sheet eroded areas.

In some parts of Tennessee, small or moderate applications of phosphorus fertilizers are effective in obtaining better stands of trees and stimulating growth during the first critical years of the

forest; and it is likely that some phosphate can be profitably used in Claiborne County. Care should be used in selecting species of trees that will adapt themselves to prevailing soil and moisture conditions.

In general, shortleaf yellow pine is well suited to reforesting moderately eroded hilly and steep areas of Clarksville, Fullerton, Muskingum, and Lehew soils. On the lower, north-facing, less severely eroded slopes and in other sites where soil and moisture conditions are favorable, tuliptree, red oak, black walnut, and white pine may be expected to do well. Because of the friable consistence and generally more favorable moisture conditions, similar forests are suited to the steep, eroded Bolton and Claiborne soils. On hilly and steep, severely eroded, shallow Montevallo and Lehew soils, Virginia pine is the only tree that will survive, but moderate success with shortleaf pine may be expected on some of the more favorable sites.

Black locust and redcedar are the trees best suited for reforestation of open areas of Rough stony land (Talbot soil material). On the rough gullied lands, yellow pine and black locust should be planted after the gullies have been stabilized by check dams. It appears that artificial planting of forest trees is not practical on Limestone rockland (rolling) or Limestone rockland (rough) because of the extremely unfavorable soil and moisture conditions, but natural reproduction of redcedar or pine should be encouraged. Likewise natural seeding is the only practical method of reforesting Rough stony land (Muskingum soil material) and Stony colluvium (Muskingum soil material).

Proper use and management of the forest resources of Claiborne County are of prime agricultural and economic importance, inasmuch as roughly half the land area of the county is now in forest. Furthermore, 53 percent of the land is physically best suited to forestry. In their present depreciated conditions, these forests continue to contribute to the income of the county; but under improved forest management practices, these contributions can be greatly increased.

The principal measures for improvement of forestry management should center about (1) controlling forest fires; (2) preventing grazing by livestock; (3) utilizing defective and cull trees for farm use and in expanded forestry industries designed to use these defective materials; (4) selectively cutting timber trees so that sound, young, valuable species are allowed to grow to maturity; and (5) reforesting with suitable species the steep, eroded, and other lands that are physically unsuited to crops or pasture. Such a program of management will result in increases in both the quantity and quality of forest growth.

Estimates indicate that a decade of good management would result in doubling the available supply of high-grade merchantable timber, and that continued good management would result in further increases that would contribute significantly to the stabilization of agricultural, economic, and social conditions in the county.

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.

Climate and vegetation are the active factors of soil genesis. They exert their influences on the parent material and change it from a heterogeneous inert mass to a body that has a definite genetic morphology. The effects of climate and vegetation on the parent material are guided, or limited, to varying degrees by the modifying influence of relief as it affects such conditions as drainage, the quantity of water that percolates through the soil, the rate of natural erosion, and the vegetation that grows on the soil. The nature of parent material also guides the course and influences the rate of action that results from the forces of climate and vegetation and is important in determining internal soil climate and the kinds of vegetation that will grow on the soil. Finally, time is involved in the changes that take place, and age becomes a factor of soil genesis as it reflects the degree of development of the soil into a body that is in equilibrium with its environment. The degree of such development depends not only on time, but also on the rate of action of the forces of climate and vegetation as that rate is guided by the factors of relief and parent material.

The factors of soil genesis are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one unless conditions are specified for the other four. They are so complex in their interrelations that many of the processes that take place in the development of soils are unknown.

The purpose of this section is to present the outstanding morphological characteristics of the soils of Claiborne County and to relate them to the factors of soil formation. Physical and chemical data are limited for these soils, and the discussion of soil genesis and morphology is correspondingly incomplete. The first part of the section deals with the environment under which the soils exist; the second, with specific soil series and the part environment has played in determining the morphology of the soils of these series.

GENERAL ENVIRONMENT AND MORPHOLOGY OF SOILS

The parent materials of soils of Claiborne County may be considered in two broad classes: (1) Materials residual from the weathering of rocks in place; and (2) materials transported by water or gravity and laid down as unconsolidated deposits of clay, silt, sand, and large rock fragments. Materials of the first class generally are related directly to the underlying rocks from which they were derived; materials of the second class to the soils or rocks from which they were washed or fell.

The residual parent materials are the residuum from the weathering of consolidated sedimentary rocks—limestone, shale, and sandstone—and the properties of these materials are strongly reflected in many of the properties of the soils that have developed from them. Geologi-

cally, the rocks are very old. They were laid down as unconsolidated sediments that were gradually converted into consolidated rocks. Those of Cumberland Mountain are nearly level or very gently folded, whereas those of the Great Valley section are severely folded and faulted and generally have a decided dip (2, 13, 14).

Certain soils developed from residual materials are generally associated with particular rock formations or parts of rock formations. Soils of the Talbott series are associated with Ordovician limestones of the Trenton, Black River, and Stone River formations (pl. 16, A). Dewey soils are derived from materials weathered chiefly from limestone of the Stone River formation. The Colbert soil is derived from materials weathered from Black River limestone and Ottosee shale of the Ordovician system. The Bolton, Claiborne, Fullerton, and Clarksville are underlain by cherty and sandy dolomites of the Copper Ridge and Beekmantown formations of Cambrian age. Most of the Armuchee soil is underlain by Reedsville shale of Ordovician age, but small portions are from materials weathered from calcareous shale of the Conasauga group, as is the soil of the Sequoia series (pl. 16, B). The Montevallo soils are underlain chiefly by acid shale of the Conasauga group and the Rome formation of Cambrian age, but a part of them is underlain by Devonian rocks of the Chattanooga formation. The Lehew soils are chiefly on the sandstone of the Rome formation of Cambrian age, but some of them are on rocks of the Juniata formation of Ordovician age. Muskingum soils in the Great Valley section are from tilted sandstone of the Clinch and Clinton formations of Silurian age, whereas the Muskingum and Hartsells soils of the Cumberland Mountain section are from level-bedded to slightly folded acid sandstones and conglomerates containing thin bands of shale, siltstone, and coal of the Pennsylvanian system, largely of the Lee, Briceville, and Anderson formations.

The profiles of the important soils derived from limestone and dolomite residuum are diagrammed in figure 3. The figure is intended to show the relations and allow comparisons of these soils derived from somewhat similar but not identical parent materials. It illustrates soil differences that apparently can be attributed largely to moderate differences in parent material. The quantity of silica in the rocks and in the soils derived from them increases from the Colbert through the Clarksville soils, and the quantity of clay decreases in the same order. The depth of solum is greatest for the Bolton soils in the middle of the diagram and decreases in either direction from the Bolton to the Colbert and from the Bolton to the Clarksville series. The diagram will reveal several other consistent relations. Parent materials together with other soil-forming factors are most favorable for the formation of the zonal Red Podzolic profile in the Bolton series and become progressively less so in either direction, the Lithosolic Colbert soil representing the extreme in one direction and the Yellow Podzolic Clarksville soils the extreme in the other.

Among the transported rock materials, the kinds of material are reflected in some of the properties of the soils that are derived from them. Soils of the Allen, Waynesboro, Holston, Monongahela, Tyler, Sequatchie, Pope, Philo, Atkins, Jefferson, and Leadvale series are derived from transported materials that consist mainly of sandstone and shale and products of their decomposition. Soils of the Etowah.

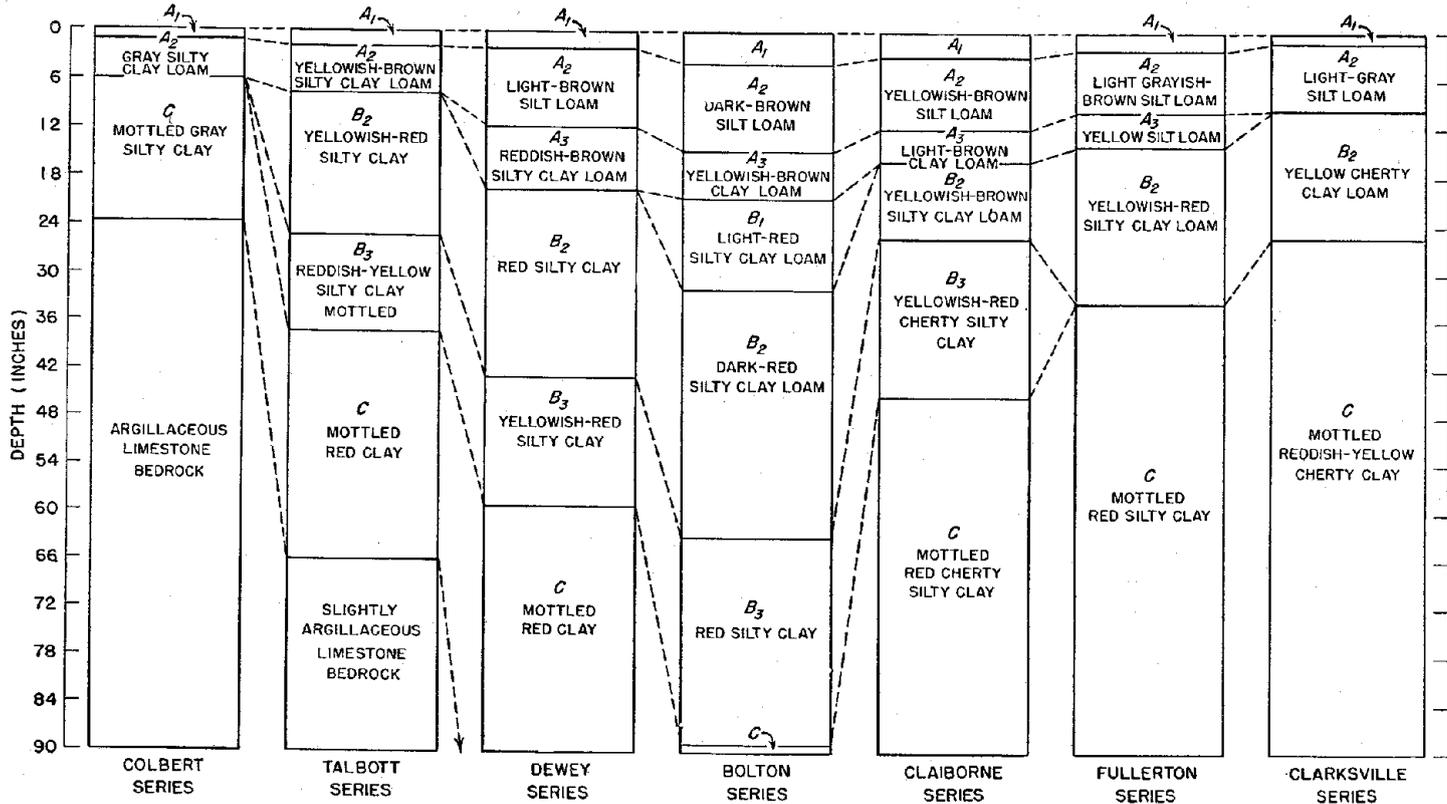


FIGURE 3.—Diagrammatic profiles of some important soil series in Claiborne County, Tenn.

Taft, Robertsville, Roane, Lindside, Melvin, Dunning, Emory, Greendale, Ooltewah, and Guthrie series are derived from transported materials that consist mainly of limestone and dolomite and products of their decomposition. Soils of the Caylor series include materials transported from both limestone material and sandstone and from shale material.

Although a rather consistent relation exists between the kinds of parent material and some of the properties of soils, other soil properties, especially those of regional significance from the standpoint of soil genesis, cannot be correlated with kinds of parent material and must be attributed to other factors.

The climate of Claiborne County is temperate and continental. Summers are long and warm, and winters short and mild. Rainfall is relatively high. The moderately high temperatures favor rapid chemical reactions under the moist conditions that exist in the soil most of the time. The high rainfall favors rather intense leaching of soluble and colloidal materials downward in the soil. The soil is frozen for only short periods and to only shallow depths in winter, which further intensifies the amount of weathering and translocation of materials.

Climatic conditions vary somewhat within the county. The climate of Cumberland Mountain is slightly cooler than that of the rest of the county. The growing season is slightly shorter, and the rainfall is slightly greater than in the Great Valley section. Some of the differences between the soils in these two major divisions of the county are caused by the differences in climate, but they are also associated with marked differences in parent material. The parent material differences are the chief factors, and climatic factors are of secondary importance in contributing to these soil differences.

The general climate of the Great Valley section is relatively uniform, but small local differences in soil climate exist due to variations in the slope and exposure of land. On the south- and west-facing slopes the average daily and annual temperature of the soil is somewhat higher than on the north- and east-facing slopes. Soil temperatures are also higher on the steeper slopes. Average moisture content of the soils is less on the south and west slopes than on the north and east slopes (?). These soil-moisture and temperature conditions affect the length of time that the soil is frozen and the growth of vegetation on the soil. Although the differences are of small magnitude, they are significant and are possibly responsible for some of the local variations in soils derived from similar parent material. Over the entire valley section, however, the differences in climate are not of sufficient magnitude to account for broad differences that exist among the soils. It appears that the relatively uniform climate of the county as a whole is responsible for some of the outstanding properties of many of the soils in common, but, because of this relative uniformity, it cannot account for the broad differences that exist in the soils.

Trees, shrubs, grasses and other herbaceous plants, micro-organisms, earthworms, and various other forms of plant and animal life live on and in the soil and are active agencies in the soil-forming processes. The nature of the changes that these various biological forces bring about depends, among other things, on the kinds of life and the life processes peculiar to each. The kinds of plants and animals

that live on and in the soil are determined by environmental factors, including climate, parent material, relief, age of the soil, and the associated organisms. The influence of climate is most apparent, though not always most important, as a determinant of the kinds of macroflora that grow on the well-drained, well-developed soils. In this way climate exerts a powerful indirect influence on the morphology of soils. Climate and vegetation acting together are the active factors of soil genesis.

A general oak-hickory-chestnut forest association was on most of the well-drained, well-developed soils of the county, although locally there may have been large proportions of pine in the forest stands. There were probably differences in the density of stands, the relative proportion of species, and the associated ground cover. Taking the county as a whole, however, the forests have been relatively uniform, and it is doubtful if any of the marked differences in properties among the well-drained, well-developed soils are the direct result of differences in vegetative cover.

Most of the trees that grow in this area are moderately deep to deep feeders on plant nutrients in the soil. They are chiefly deciduous and shed their leaves annually. The leaves range considerably among species in content of various plant nutrients, but, in general, the quantities of bases and phosphorus returned to the soil in leaves of deciduous trees is high compared to those of coniferous trees. In this way, essential plant nutrients are returned to the upper part of the soil from the lower part and retard the depleting action of percolating waters.

Much organic material is added to the soil in the form of dead leaves, roots, and entire plants. Most of it is added to the A horizon where it is acted upon by micro-organisms, earthworms, and other forms of life and by direct chemical reactions. In Claiborne County, the rate of decomposition of such materials is rather rapid as a result of favorable temperature and moisture conditions, favorable character of the organic material itself, and presumably favorable micropopulation of the soil. Organic material does not accumulate on well-drained sites in this county to the extent that it does in cooler regions under similar conditions of drainage.

Little is known of the micro-organisms, earthworms, and other population of the soils of the county, but their importance is probably equal to that of the vegetation on the soil.

The well-drained, well-developed soils have been formed under relatively similar conditions of climate and vegetation. It is on these soils that climate and vegetation have had the maximum influence with the minimum of modification by relief and age. As a result, the soils developed from various kinds of parent materials have many properties that are common to all.

In the virgin conditions, all the well-drained, well-developed soils have a layer of organic debris on the surface in varying stages of decomposition. All have dark-colored A₁ horizons. The A₂ horizon is lighter colored than either the A₁ or the B; the B is generally uniformly colored yellow, brown, or red and is heavier textured than the A₁ or A₂; and the C is variable in color and texture among the different soils, but it is usually light red or yellow mottled with gray or brown.

Analysis of samples of several comparable soils from Jefferson County, Tenn., may be expected to apply to these soils (8). The silica content decreases and the alumina and iron contents increase with depth. The content of organic matter is moderate in the A₁ horizon, less in the A₂ horizon, and very low in the B and C horizons. The soils are low in bases and phosphorus within the solums. In general, the loss on ignition was low, indicating a low content of very tightly held water. The reaction is medium, strongly, or very strongly acid throughout the solum. In general, the quantity of silt decreases and the quantities of clay and colloid increase with depth from the A₁ horizon through the C horizon. The colloid content of the B horizon is much higher than the A₂ horizon.

The properties mentioned above are common to all well-developed, well-drained soils that have been subjected to similar conditions of climate and vegetation. They are, therefore, common to soils of zonal extent, and all soils that exhibit them are called zonal soils. Zonal soils are members of one of the classes of the highest category in soil classification and are defined as those great groups of soils having well-developed soil characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms (12).

In places in Claiborne County where the parent material has been in place a long time and has not been subject to extreme conditions of relief or of the parent material itself, the soils developed have the characteristics of zonal soils. In places where the parent material has been in place only a short time, as in the case of recently transported materials, the soils have poorly defined or no genetic horizons. These soils are young and have few or none of the properties of zonal soils and, therefore, are called azonal soils. Azonal soils are members of a second class of the highest category of soils classification and are defined as a group without well-developed soil characteristics either because of their youth or because of conditions of parent material or relief that have prevented the development of definite soil characteristics (12).

These azonal soils have A₁ horizons that are moderately dark to very dark and apparently have a moderately to fairly high content of organic matter; by the absence of a zone of illuviation, or B horizon; and by parent material that is usually lighter in color than the A₁ horizon and that may be similar to, lighter than, or heavier than the A₁ horizon in texture. Because of the absence of a B horizon they may be referred to as AC soils.

The relief of soils of the county ranges from nearly level to very steep. On some steep areas where the quantity of water that percolates through the soil is relatively small and where the large quantity of water that runs off the soil and the rapid rate of runoff contribute to relatively rapid geologic erosion, the soils are young. The materials are constantly renewed or mixed, and the changes brought about by vegetation and climate may be so slight that the soils are essentially AC soils. These soils are also azonal soils.

On some nearly level areas where both internal and external drainage are restricted or where geologic erosion is very slow, soils whose materials have been in place a long time have certain well-developed profile characteristics that zonal soils do not have. Such soils are associated geographically with the zonal soils and are called intra-

zonal soils. They are defined as soils with more or less well-developed soil characteristics that reflect the dominating influence of some local factor of relief or parent material over the normal effects of climate and vegetation (12). The properties of such soils in this county are generally the result of level relief influenced greatly by the character of the parent material and the kinds of vegetation that grow in such environments.

Soils of each of the three broad classes—zonal, azonal, and intrazonal—may be derived from similar kinds of parent material. Within any one of these classes major differences among soils are closely related to differences in the kinds of parent materials from which derived. The thickness of soils developed from residual materials over the rock from which derived is a partial function of the resistance of the rock to weathering, the volume or residuc after weathering, and the rate of geologic erosion. The chemical and physical nature of the parent material modifies the rate and direction of chemical changes that result from climate and vegetation. The kind of parent material also exerts a pronounced influence on the kinds of vegetation that grow on the soil.

Rocks have contributed to differences among soils also through their effects on relief. The rocks of most of Claiborne County are of very old formations that are folded and faulted (9, 13, 14). The present relief is probably largely a product of geologic weathering and erosion of these formations—the higher lands are capped by more resistant rocks, whereas the valleys are underlain by the less resistant rocks (2). The ridges are capped either by cherty dolomite, interbedded sandstone and shale, acid shale, or sandstone or conglomerate; and the valleys are underlain by moderately pure limestone, interbedded shale and limestone, or by soft shale.

The properties of soils developed from residual materials are generally closely related to the underlying rocks; therefore the distribution of soils is also related to the valleys and ridges. Dewey, Talbott, and Colbert soils are chiefly in rolling upland valleys; Clarksville, Fullerton, Claiborne, Bolton, Montevallo, Armuchee, and Lehew soils are on valley ridges; and Muskingum and Hartsells soils are on the high valley mountains and Cumberland Mountain. Streams in the ridges and mountains generally have steeper gradients than those in the valleys. As a result of faster stream cutting and greater relief from the stream floors to the dividing ridge crests, most of the soils of the ridges and mountains have steeper slopes than those of the valleys. In this way, the character of the rocks has contributed indirectly to the properties of some soils through relief.

The internal drainage of soils of nearly level relief in the limestone areas is exceptionally good as a result of good subterranean drainage through caverns and crevices in the sharply dipping rocks. This excellent subterranean drainage in the areas underlain by limestone counteracts the usual effects of gentle relief on drainage and allows the nature of the parent rock to dominate local differences among the well-developed, well-drained soils derived from residual materials—soils that are subject to similar forces of climate and vegetation.

DESCRIPTION OF SOILS REPRESENTING THE GREAT SOIL GROUPS

The classification of the soil series of Claiborne County is shown in table 9. These are listed according to order and great soil group. The

various series are listed under each group. The source and kinds of parent material of each series are shown together with the outstanding characteristics of the soil profile itself. This table will enable the reader to understand more easily the genetic relations of the soils of the county.

RED PODZOLIC SOILS

Red Podzolic soils are a zonal group having thin organic and organic-mineral layers over a yellowish-brown leached layer that rests on an illuvial red horizon and is developed under a deciduous or mixed forest in a warm-temperate moist climate (6). The soil-forming processes involved in their development are laterization and podzolization. These soils have the common characteristics of Red Podzolic soils, and apparently all have developed under relatively similar conditions of climate and vegetation. They are well drained, and, although they range somewhat in degree of maturity, all are sufficiently old to have at least a moderately well-developed Red Podzolic soil profile; they range from level to steep, but differences in profile are probably not due primarily to differences in slope gradient. There are marked differences in parent material of the various soils, and many of these can be correlated with differences in parent material.

TALBOTT SERIES

Soils of the Talbott series are characterized by heavy-textured B and C horizons, a property that is associated with the argillaceous limestone from which their parent material is derived. They are relatively thin over bedrock and their position, relief, and thickness suggest that the limestone weathers rapidly and leaves a relatively small quantity of insoluble residue; they are eroded readily when cultivated and may have eroded rather rapidly under natural vegetation, which probably accounts in part for their thinness over bedrock. Like the other zonal soils, they have developed under a deciduous forest vegetation and a warm-temperate moist climate. The soils are medium to strongly acid throughout the profile.

DEWEY SERIES

Soils of the Dewey series are developed from the residuum of limestone that is higher in some insoluble materials, particularly silica, than the rocks underlying soils of the Talbott series. They are also generally thicker over bedrock and darker and red throughout the profile and have more organic matter in the upper layers, and the texture is generally lighter throughout. They have slightly stronger relief in many places than the Talbott soils, the climate is similar, but the vegetation, especially the ground cover, may have been slightly more dense. It is probable that the major differences in the two series are directly or indirectly the result of differences in parent material.

The following virgin profile description is of Dewey silt loam. Most of the soil is now cleared and the A₁ and A₂ horizons are mixed. In places most of these layers may have been removed by accelerated erosion and the A₃ horizon is now at or near the surface.

- A₁. 0 to 3 inches, brown friable silt loam with a fine-crumb structure; moderately high in organic matter and heavily matted with tree rootlets; pH, 4.5 to 5.5.²⁴

²⁴ pH determinations were made with a Lamotte-Morgan quick-test kit at the time that soil samples were collected in the field.

TABLE 9.—Classification of the soil series or types of Claiborne County, Tenn., in higher categories

ZONAL SOILS

Great soil group and soil series or type	Topographic position	Parent material	Relief	A horizon	B horizon
Red Podzolic soils:					
Talbott.....	Limestone valley uplands.	Residuum from— Argillaceous limestone.....	Undulating to rolling.....	Grayish-brown silt loam or silty clay loam.	Yellowish-red silty clay; sticky and plastic.
Dewey.....		High-grade or slightly cherty limestone.	Undulating to steep.....	Grayish-brown or brown silt loam.	Yellowish-red or red silty clay.
Bolton.....	High cherty ridges.....	Cherty and arenaceous dolomites.	Rolling to steep.....	Dark reddish-brown silt loam; mellow and friable.	Dark-red silty clay loam; friable and mellow.
Claiborne.....			do.....	Brown silt loam; friable.....	Yellowish-brown silty clay loam; moderately friable.
Fullerton cherty silt loam.			do.....	Brownish-gray silt loam; cherty.	Yellowish-red or light-red silty clay loam; cherty.
Fullerton loam.....			do.....	Gray loam; cherty.....	Yellowish-red light silty clay loam; cherty.
Caylor.....	Old colluvial fans and benches.	Old local alluvium from— Limestone, shale, and sands.	Gently sloping to sloping..	Brown silt loam; friable.....	Yellowish-brown silty clay or silty clay loam.
Allen.....		Chiefly sandstone with some limestone influence	Rolling.....	Light-brown fine sandy loam.	Yellowish-red to red fine sandy clay to sandy clay loam.
Etowah.....	Old rolling stream terraces.	Old stream alluvium from— Limestone.....	Gently sloping to sloping..	Grayish-brown or light-brown silt loam.	Brownish-red silty clay loam.
Waynesboro.....		Acid sandstone.....	Gently sloping to rolling..	Grayish-brown fine sandy loam.	Red or yellowish-red fine sandy clay.
Yellow Podzolic soils:					
Clarksville cherty silt loam.	High cherty ridges.....	Residuum from— Cherty dolomites.....	Rolling to steep.....	Light-gray cherty silt loam..	Yellow or brownish-yellow cherty silty clay loam.
Sequoia.....	Shale valley uplands.....	Interbedded limestone and shale.	Rolling.....	Grayish-brown silty clay loam.	Brownish-yellow silty clay loam.
Hartsells.....	Narrow mountaintops.....	Massive fine-grained sandstone.	Undulating.....	Yellowish-gray fine sandy loam; stony.	Yellow fine sandy clay loam; stony.
Holston.....	Level to gently sloping stream terraces.	Old stream alluvium from— Acid sandstone and shale.	Nearly level to sloping...	Gray to grayish-yellow fine sandy loam.	Yellow fine sandy clay; faintly mottled.
Sequatchie.....		Sandstone, shale, and some limestone.	do.....	Light-brown or yellowish-brown fine sandy loam.	Yellowish-brown fine sandy loam to fine sandy clay.
Jefferson.....	Old colluvial fans and benches.	Recent local alluvium from— Muskingum soils and sandstone stony land.	Gently sloping to sloping..	Gray or yellowish-gray fine sandy loam.	Brownish-yellow silty clay loam or sandy clay loam.
Leadvale.....		Montevallo and Lehev soils.	Nearly level to sloping....	Light grayish-brown or grayish-yellow silt loam.	Yellow silty clay loam or silty clay, mottled layer at 24 to 36 inches.

Planosols: Monongahela.....	} Level to gently sloping stream terraces.	Sandstone and shale.....	{ Nearly level.....	Grayish-brown to gray silt loam.	Yellow or brownish-yellow silt loam or light silty clay loam; hardpan at 18 to 24 inches.
			{ Level.....	Light yellowish-gray silt loam; some mottles.	Gray silt loam; to silty clay loam; highly mottled.
		Limestone.....	{ Nearly level.....	Light-gray silt loam.....	Grayish-yellow to bright-yellow clay loam to silty clay loam; hardpan at about 30 inches.
			{ Level.....	Light-gray clay loam; mottled.	Gray silty clay; sticky, plastic, mottled.

AZONAL SOILS

Lithosols: Colbert.....	} Limestone valley uplands.	Argillaceous limestone.....	Undulating to rolling.....	Dark-gray shallow silty clay loam over yellow or greenish-yellow sticky plastic silty clay; bedrock at 24 inches.		
			Hilly to steep.....	Yellow-brown shallow silt loam underlain by brownish-red silty clay mixed with shale; bedrock at about 24 inches.		
		Steep-sloped knobs and ridges.	Interbedded limestone and shale.....	do.....	Brownish-gray shallow silt loam mixed with shale; bedrock at less than 20 inches.	
			Interbedded sandstone and shale.....	do.....	Brown or purplish-brown shallow fine sandy loam mixed with shale and sandstone fragments; bedrock at about 18 inches.	
Muskingum.....	} Mountain slopes.....	Massive sandstone and conglomerate.....	do.....	Grayish-yellow to yellow shallow fine sandy loam, underlain by brownish-yellow fine sandy clay; bedrock at about 24 inches.		
		Recent stream alluvium from.....				
Alluvial soils: Roane..... Lindsie..... Melvin..... Dunning..... Pope..... Philo..... Atkins..... Emory..... Greendale..... Ooltawah..... Guthrie.....	} Stream bottom lands.....	Cherty dolomite.....	{ Nearly level.....	Brown silt loam, cemented layer at about 18 inches; well drained.		
			{ do.....	Brown silt loam, underlain by mottled gray silty clay to silty clay loam; imperfectly drained.		
		Dolomite and high-grade limestone.....	{ Level.....	Gray mottled silt loam, poorly drained.		
			{ do.....	Nearly black heavy silty clay loam underlain by heavy gray silty clay; mottled; poorly drained.		
		Argillaceous limestone.....	{ Nearly level.....	Grayish-brown fine sandy loam; well drained.		
			{ do.....	Grayish-brown fine sandy loam, underlain by mottled gray fine sandy loam; imperfectly drained.		
		Chiefly acid sandstone with some acid shale influence.....	{ Level.....	Mottled gray silt loam; poorly drained.		
		Recent local alluvium from—Dewey, Claiborne, and Bolton soils.....	} Young to very young colluvial fans and benches.	Clarksville and Fullerton soils.....	Gently sloping to sloping.....	Brown friable deep heavy silt loam; well drained.
					Nearly level to sloping.....	Gray or light grayish-brown silt loam underlain by brownish-yellow or yellow silt loam or silty clay loam; cherty; well drained.
Talbot, Dewey, Fullerton, and Clarksville soils.....	}	}	{ Nearly level.....	Light-brown or grayish-brown silt loam underlain by mottled gray silty clay loam; imperfectly drained.		
			{ do.....	Mottled gray or yellowish-gray silt loam underlain by heavy dark-gray silty clay; poorly drained.		

- A₂. 3 to 12 inches, light-brown to dark grayish-brown friable silt loam containing a few fine chert fragments and having a fine-crumb structure; moderately well supplied with organic matter; small tree rootlets are numerous; pH, 4.5 to 5.5.
- A₃. 12 to 20 inches, light reddish-brown light silty clay loam with a fine-crumb structure. This material, containing some fine chert fragments and some small dark-brown concretions, crushes to a smooth mass when moist, but when wet it is somewhat sticky; pH, about 5.0.
- B₂. 20 to 44 inches, brownish-red to red heavy silty clay loam containing many small dark-brown concretions and some fine chert fragments. The layer has subangular nut structure; the surface of the aggregate is coated with glossy-red and yellow material, and the structure particles crush to a yellowish-red fine crumbly mass; pH, 4.5 to 5.0.
- B₃. 44 to 60 inches, red or yellowish-red silty clay that has a firm nut structure and contains small chert fragments and many small dark-brown concretions. The material is sticky when wet and hard and brittle when dry, and the face of the structure particles is covered with thin deep-red coatings; pH, 4.5 to 5.0.
- C. 60 to 80 inches, heavy-red clay or silty clay containing mottlings of gray, yellow, brown, ocher, and olive. The material is very sticky and plastic when wet; has a fairly distinct subangular nut structure; and contains many small weathered chert fragments; pH, about 4.5.

BOLTON SERIES

The soils of the Bolton series, like those of the Claiborne, are on or near the crests of high, steep ridges underlain chiefly by cherty and arenaceous dolomite, in close geographical association with the Fullerton soils. They complete a group, together with the Fullerton and Claiborne series, of Red Podzolic soils derived from materials weathered from dolomite. The general type of relief, the age, parent material, climate, and vegetation of all of these soils are similar but local variations in one or more of these factors is responsible for the differences among them. The Bolton soils differ from the Fullerton in being darker in all layers, higher in organic matter, more fertile, less acid, much less cherty, more friable, especially in the B and C horizons, and the solum is deeper. They differ from the Dewey soils in being more friable in the B and C horizons, much less erosive, much deeper over bedrock and in being on or near the crests of some of the highest cherty ridges of the county rather than in low-lying upland valleys. In general, the Bolton soils are the darkest colored, least erosive, and most friable of all of the Red Podzolic soils developed from either limestone or dolomite material.

No completely satisfactory explanation of the differences between these soils and those of the Fullerton series can be given, but local differences in soil climate and especially parent material are largely responsible. As with the Claiborne soils, the Bolton soils are chiefly on the north- and east-facing slopes with a cooler, moister soil climate that encourages more vigorous plant growth, which together with less leaching, results in a less acid soil with more organic matter and more plant nutrients. Geologic erosion appears to be less rapid and a thicker solum is developed. Much of this soil is developed on thin layers or lenses of a nearly chert-free, slightly arenaceous dolomite that is responsible for the chert-free character of the soil and its friable consistence. The abundant small brown concretions in the B horizon are partly oxides of manganese, and it is possible that small quantities of these oxides are partly responsible for the dark reddish-brown color. There are undoubtedly other unknown factors contributing

to the differences that exist between these soils and those of the Fullerton and Claiborne series.

The following is a description of a virgin profile of Bolton silt loam:

- A₁. 0 to 4 inches, dark-brown soft mellow friable silt loam that is high in organic matter; pH, 6.0 to 6.5.
- A₂. 4 to 15 inches, dark-brown to reddish-brown soft mellow friable silt loam with a fine-crumb structure; moderately high in humus; numerous small tree rootlets are present; pH, about 6.0.
- A₃. 15 to 20 inches, yellowish-brown friable heavy silt loam with a fine-crumb structure. This layer is firmer in consistence and heavier in texture than the A₁ and A₂ layers; pH, 5.5 to 6.0.
- B₁. 20 to 32 inches, light-red silty clay loam containing flecks and siftings of brown and yellow material from the layers above. This material crushes to a soft smooth yellowish-brown mass containing a few fine chert fragments and some small dark-brown concretions; pH, 5.5 to 6.0.
- B₂. 32 to 62 inches, dark-red to brownish-red moderately friable silty clay with a weakly developed fine subangular nut structure. This material is easily crushed to a soft smooth brown mass when moist, but it is somewhat sticky when wet; contains many small dark-brown concretions and a few fine weathered chert fragments. The faces of the structure particles are covered with dark-brown glossy coatings; pH, 5.0 to 5.5.
- B₃. 62 to 90 inches, red silty clay similar to that of the B₂ layer except that it is slightly heavier in texture, slightly lighter in color, and contains more chert fragments; pH, 4.5 to 5.0.
- C. 90 to 105 inches, red silty clay containing light mottlings of yellow and gray. The material has a distinct fine nut structure; is moderately friable when moist and crushes to a smooth red mass, but it is moderately sticky and plastic when wet; contains fine chert fragments and a few large angular pieces of chert; pH, about 4.5. Dolomite bedrock is at a depth of 30 to 50 feet.

At present much of the soil is cleared and the A₁ layer is mixed with the upper part of the A₂. In places part of this layer is missing because of erosion, but in very few places is enough missing so that the A₃ layer is exposed at the surface or turned by tillage operations.

CLAIBORNE SERIES

The soils of the Claiborne series are chiefly on the crests and upper slopes of high, steep ridges underlain by cherty or sandy dolomite of the Knox formation. They are closely associated with the Fullerton soils geographically and, in general, the parent material, climate, and vegetation of the two soils are similar. The factors that are responsible for the differences between them are not known, but a few partial explanations are presented here. Local differences in soil climate offer one explanation. Much of the Claiborne soil is on north- or northeast-facing slopes. It is definitely known that soil temperature is lower and soil moisture higher on such sites (?). This lower temperature results in longer and more severe freezing of the soil in winter, which would prevent leaching and inhibit bacterial activity.

The more favorable moisture and temperature conditions result in a slightly different kind and more vigorous growth of vegetation. In most places maple, beech, and tuliptree are the dominant tree species on this soil, and in general they return a greater quantity of organic matter that is higher in bases and phosphorus than the oak and hickory that prevail on most Fullerton soils. Thus a more favorable soil climate encourages more vigorous vegetative growth resulting in a less leached, darker colored soil that is higher in or-

ganic matter, bases, and plant nutrients. It is also suggested that local differences in parent material may be partly responsible for the soil development, inasmuch as it is closely associated with some of the sandy layers in the dolomite in many places. Neither of these explanations is entirely satisfactory, however, because the soil is in some places apparently associated with neither of the factors discussed. These factors, however, together with some that are now unknown, are responsible for the morphology of the soil.

The following profile of Claiborne silt loam was developed under a forest of maple, beech, tuliptree, chestnut, a few oak, and dogwood:

- A₁. 0 to 3 inches, dark grayish-brown mellow friable silt loam high in organic matter; heavily matted with tree rootlets; pH, about 5.5.
- A₂. 3 to 12 inches, yellowish-brown to brown mellow friable silt loam with a fine-crumb structure. This layer contains a few small chert fragments and is fairly well supplied with organic matter; tree rootlets are plentiful; pH, 4.5 to 5.0.
- A₃. 12 to 16 inches, yellowish-brown light silty clay loam that has a firmer consistence and a smaller content of organic matter than the A₂ layer; pH, 4.5 to 5.0.
- B₂. 16 to 26 inches, yellowish-brown silty clay loam with a distinct but weak nut structure. This material is moderately friable when moist and crushes to a smooth dark brownish-yellow mass; moderately sticky when wet; contains some chert fragments and small dark-brown concretions; pH, 4.5 to 5.0.
- B₃. 26 to 46 inches, yellowish-red silty clay loam with a firm, well-developed nut structure. The structure particles have red and yellow glossy coatings. This material is heavier in texture and more sticky and plastic than the B₂ layer and contains a large quantity of angular chert fragments; pH, about 4.5.
- C. 46 to 60 inches, bright-red heavy silty clay with a well-developed firm nut structure. The structure particles are coated with red, yellow, ocher, and olive; and the soil material itself is mottled with these colors. This material is somewhat compact in place but when disrupted it is moderately friable if moist and sticky and plastic if wet and contains much angular chert ranging in size from 1 to 6 inches; dolomite bedrock is at depths of 20 to 50 feet; pH, 4.0 to 4.5.

As with other upland soil, where cleared the A₁ and A₂ horizons are mixed and in most places part of the layer is missing because of loss through accelerated erosion. In general, these soils have a greater moisture-holding capacity and therefore are less susceptible to erosion than are the Fullerton soils.

FULLERTON SERIES

Fullerton soils are developed from residual material chiefly from dolomite but to a lesser extent from dolomitic limestone that is high in insoluble materials, chiefly silica. The silica is chiefly in the form of chert, but locally calcareous sandstone beds in the dolomite have contributed to the parent material of these soils. These soils commonly occupy higher positions, are deeper, less fertile, less erosive, more cherty, and have steeper slopes than the Dewey and Talbott soils, which have similar but not the same kind of parent material. The parent material of the Fullerton soils differs from those of the Talbott and Dewey soils in two important respects: (1) It is derived from and underlain by dolomite rather than limestone and under ordinary atmospheric and aqueous conditions dolomite alters like limestone but less readily (1), and (2) it contains a greater quantity of insoluble

material, principally silica, than do either the Talbott or Dewey soils. It is generally true that the quantities of insoluble material in the parent rocks increase from the Talbott through the Dewey to the Fullerton soils. Associated with this increase is generally an increase in the chertiness, thickness, and permeability, and a decrease in the content of plant nutrients, cohesive properties, and susceptibility to erosion of the soils. The lower susceptibility to erosion of the soils and the greater volume of residue from weathering of the rocks apparently results in a thicker mantle of unconsolidated rock material over bedrock under the Fullerton soils than under Talbott or Dewey soils. This mantle probably protects the bedrock from rapid weathering and together with the fact that dolomite weathers more slowly than limestone may largely account for the higher position on the landscape and the resultant steeper slopes of the Fullerton than of the Talbott or Dewey soils.

The profile of Fullerton silt loam, described below, was developed under a mixed forest of red, white, and black oaks, chestnut, hickory, and blackgum, with huckleberry, chinquapin, and dogwood prominent in the undergrowth.

- A₁. 0 to 1½ inches, gray loose silt loam stained with organic matter. This layer is heavily matted with tree rootlets; pH, 5.5 to 6.0.
- A₂. 1½ to 10 inches, light grayish-brown friable silt loam with a fine-crumb structure. This material is low to medium in organic matter and contains many small tree rootlets; small chert fragments are plentiful; when dry the material is light gray; pH, 5.0 to 5.5.
- A₃. 10 to 14 inches, yellow to grayish-yellow friable heavy silt loam streaked and splotted with gray siftings from the A₂ layer. This material breaks into small, soft, rounded, nutlike aggregates that easily crush to a yellow smooth mass; contains some fine chert fragments, pH, 4.0 to 4.5.
- B₂. 14 to 34 inches, yellowish-red silty clay loam with a well-developed, moderately firm, subangular nut structure. This material is moderately friable when moist but sticky and plastic when wet; when dry it crushes to a fine crumbly reddish-yellow mass, and contains a small quantity of fine chert fragments; pH, 4.0 to 4.5.
- C. 34 to 60 inches, red silty clay with a well-developed nut structure. Structure particles are covered with glossy coatings of yellow, brown, ocher, and gray, and the soil material is mottled with these colors. Small hard black concretions are in the upper part of this layer, which contains angular chert fragments, the relative proportion increasing with depth; pH, about 4.0. Cherty dolomite bedrock is at depths of 20 to 50 feet.

Much of the soil is now cleared and cultivated. In these places the A₁ and A₂ layers are mixed, and the organic matter is largely dissipated. In places part or all of this surface layer and part of the A₃ layer are missing because of loss through accelerated erosion, and the B₂ layer is at or near the surface.

CAYLOR SERIES

The soils of the Caylor series are on colluvial fans and benches at the foot of valley mountain slopes in limestone valleys. Their parent material includes local alluvium and colluvium washed from sandstone, calcareous shale, and limestone. They were developed under a hardwood forest under a climate similar to that under which the other mature soils of the county developed and have nearly level to strongly sloping relief. As mapped they are closely associated geographically with the Armuchee and Talbott soils.

In position and source of parent material the Caylor soils are somewhat similar to the Allen soil but differ from it in being more brown, less leached, and therefore less acid and more fertile. The differences are apparently due to age, parent material, and possibly soil climate. In general the material from which the Caylor soils are developed contains a higher proportion of limestone material and in addition they probably receive some annual increments of lime from seepage waters and runoff from the surrounding mountain slopes. These waters run over and percolate through the material on the mountain foot slopes where the soils are formed. These increments of material replenish the bases of the soil that may be responsible for its less leached appearance and apparent younger profile than that of the Allen soil.

Inasmuch as Claiborne County is in the extreme northern part of the region of Red and Yellow Podzolic soils it is possible that local differences in site might induce sufficient differences in soil climate to permit the formation of Gray-Brown Podzolic soils. Such local variations may be responsible for the development of the brownish B horizon of the Caylor soils.

The following is a description of a virgin profile of Caylor silt loam:

- A₁. 0 to 1 inch, dark-gray to nearly black friable silt loam. The dark color is apparently due to its high content of organic matter. This layer is heavily matted with tree rootlets; pH, 5.5 to 6.0.
- A₂. 1 to 8 inches, light-brown to grayish-brown smooth mellow friable silt loam with a fine-crumb structure. This material is moderately high in organic matter and contains many small tree rootlets; pH, about 5.0.
- A₃. 8 to 12 inches, brownish-yellow silty clay loam with an indistinct sub-angular nut structure. This material is moderately friable when moist and crushes to a smooth brownish-yellow mass; it is somewhat sticky when wet; pH, about 5.0.
- B₁. 12 to 34 inches, yellowish-brown light silty clay with a fine subangular nut structure. This material is moderately firm in place but easily disrupted, and the structural aggregates are fairly easily crushed to a crumbly brownish-yellow mass when moist; when wet it is sticky and plastic; pH, 4.5 to 5.0.
- C. 34 to 60 inches, yellowish-brown silty clay mottled with red, brown, and yellow. This material is easily disrupted into angular nutlike aggregates that may be crushed into a moderately friable mass when moist, but the material is sticky and plastic when wet; it contains some fragments of green, yellow, purple, and red shale and sandstone, small pieces of chert, and a few soft small brown concretions. This layer is underlain at variable depths by limestone residuum or high-grade limestone bedrock; pH, about 5.0.

Nearly all the soil is cleared and cultivated so that the upper layers are mixed. In very few places is the soil sufficiently eroded so that the B horizon is turned by tillage operations.

ALLEN SERIES

The Allen soil has gently sloping to strongly sloping relief and is developed under deciduous forest and a climate similar to that under which the Waynesboro soil is developed. It is developed from parent material that consists chiefly of colluvial and local alluvial materials that have come mainly from uplands underlain by sandstone, conglomerate, and shale with some limestone influence. The physical condition of the parent material is such that there is free movement of

percolating waters, and the supply of bases is sufficiently low to promote rapid development of properties of a mature genetic profile.

In many places Jefferson soils with azonal profiles or with weakly developed Yellow Podzolic profiles are developed on what, superficially at least, appears to be parent material similar to that of the Allen soil. The differences between the two soils can be accounted for, at least in part, by differences in parent material and age. In Claiborne County all the Allen soil is influenced to some degree by calcareous material. Practically all of it is underlain at considerable depth by high-grade limestone bedrock, and most of it is in positions influenced to some extent by waters that flow over or through limestone material. In contrast, practically all the Jefferson soils are underlain by acid rocks, and percolating waters flow only through noncalcareous material. As mapped all the Allen soil is removed some distance from the slopes from which the major parts of its parent material was washed. The face of the mountain slopes is being eroded away and is slowly retreating so that the colluvial benches are left some distance out in the valley. As a result the Allen soil does not receive annual increments of colluvial material. On the other hand the Jefferson soils are on benches immediately adjacent to the mountain slopes and they do receive increments of soil material at frequent intervals; such increments accumulating in most places at a rate nearly as rapid as soil-forming process can act.

The following is a description of a profile of Allen loam:

- A₁. 0 to 1 inch, dark-gray friable loam; high in organic matter; pH, about 6.0.
- A₂. 1 to 8 inches, grayish-brown to light-brown friable mellow loam with a fine-crumb structure; relatively low in organic matter; pH, 5.0 to 5.5.
- B₁. 8 to 16 inches, yellowish-brown to light-brown silty clay loam, friable when moist but somewhat brittle when dry; has no definite structure and is easily crushed to a soft smooth yellowish-brown mass; pH, 5.0 to 5.5.
- B₂. 16 to 28 inches, bright-red silty clay that breaks into small rounded nut-like aggregates; moderately friable and crushes to a smooth red mass when moist, but it is sticky when wet; contains some small black concretions; pH, 5.0 to 5.5.
- B₃. 28 to 45 inches, red to yellowish-red light silty clay that is more friable than that of the B₂ layer and it breaks into a crumbly mass; it is less sticky when wet; a few small sandstone and shale fragments may be present; pH, 5.0 to 5.5.
- C. 45 to 84 inches, dominantly red material containing heavy mottlings of yellow, gray, olive, and green that ranges in texture from a silty clay to fine sandy clay; is moderately friable when moist but somewhat sticky and plastic when wet; contains many fragments of partly weathered gray and red sandstone, yellow, red, and gray shale, and many quartz pebbles; pH, about 4.5.

ETOWAH SERIES

The soil of the Etowah series is moderately well developed from moderately old alluvium washed mainly from soils underlain by limestone. It has relatively open substratum that favors rapid leaching, but the relatively high fertility of this soil, together with favorable moisture conditions, has encouraged a heavy forest growth resulting in the relatively high content of organic matter in the upper layer. In many properties, especially color, the Etowah soil resembles the Dewey soils, but it generally has a more friable, somewhat lighter textured B horizon than the Dewey soils.

WAYNESBORO SERIES

The soil of the Waynesboro series is a well-developed Red Podzolic soil formed from very old deposits of alluvium that consist mainly of the residue weathered from sandstone and shale and some limestone. It is lighter in texture and more friable in consistence in the B horizon than are the Red Podzolic soils from the residuum of weathered limestone. Its substratum is pervious to water and does not retard greatly the leaching of the soil mass. The parent material is low in bases and probably in other elements, compared to the parent material of the Etowah soil, and this factor, together with the greater age of this soil, is responsible for the chief differences between them. The properties of the parent material would be expected to permit somewhat more rapid development of a mature soil than would those of parent materials of Dewey and Etowah soils. The vegetative cover of the Waynesboro soil is less luxuriant than that of the Etowah soil as a result of a lower nutrient level, and this factor probably contributed to the lower organic-matter content and the light color of the surface layer.

YELLOW PODZOLIC SOILS

Yellow Podzolic soils are a zonal group having thin organic and organic-mineral layers over a grayish-yellow leached layer that rests on a yellow horizon (6). They have undulating to steep relief and developed under a forest vegetation consisting mainly of deciduous trees with a considerable admixture of pines in some places. There may have been more pines and a somewhat less luxuriant and different kind of undergrowth on the Yellow Podzolic soils than on the Red Podzolic soils, although the degree of uniformity of such a relation is unknown. Climatic conditions on the soils of the two groups are apparently similar. The parent materials were derived from cherty dolomite, interbedded limestone and shale, and old sandy terrace material.

The causes of development of pronounced color differences between the Yellow Podzolic and the Red Podzolic soils are not known. The Yellow Podzolic soils, however, are generally associated with parent material either lower in bases or less well drained internally than that of the Red Podzolic soils.

CLARKSVILLE SERIES

The soils of the Clarksville series are closely associated geographically with the Fullerton soils, but they are developed from materials residual from the weathering of dolomite that is much more siliceous than the dolomite from which the Fullerton soils are derived. They developed under a forest that was largely deciduous and are generally less subject to erosion, more cherty, and thicker over bedrock. They complete the group of zonal soils developed from limestone and dolomite, namely, Talbott, Dewey, Bolton, Claiborne, Fullerton, and Clarksville.

It is possible that the parent material of the Clarksville soils may have many of the same effects that materials weathered from sandstone have on the soils that develop from them. The highly siliceous dolomite is weathered to a great depth and apparently the residuum has lost most of its bases. The residuum is strongly acid and has

a low base exchange capacity, indicating that the siliceous part of the residuum dominates the parent material. The thick covering of disintegrated rock protects the unweathered rock and accounts in part for the high positions Clarksville soils occupy and the resultant steepness of some of the slopes. These soils are not so susceptible to erosion as the other soils developed from dolomite residuum, a condition that may be partly responsible for the thickness of weathered material over bedrock.

The following profile of Clarksville cherty silt loam was developed under a forest of chestnut, post and black oaks, hickory, blackgum, sourwood, red maple, and chestnut with huckleberry, dogwood, serviceberry, and blackhaw in the undergrowth.

- A₁. 0 to 1 inch, light-gray loose silt loam stained with organic matter. This layer is heavily matted with tree rootlets; pH, 4.5 to 5.0.
- A₂. 1 to 10 inches, pale yellowish-gray to light-gray loose friable silt loam. When dry this layer is almost white in color; it is low in humus, and contains many angular chert fragments ranging from 1 to 3 inches in size; pH, about 5.0.
- B₂. 10 to 26 inches, yellow light clay loam with no distinct structure. This material is slightly brittle but is easily shattered to a loose, powdery, yellow mass containing a large quantity of angular chert fragments and some small black concretions. In places the lower part of this layer may be brownish yellow in color and have weakly developed nut structure; pH, 4.0 to 4.5.
- C. 26 to 40 inches, brownish-yellow gritty clay loam, heavily mottled with gray, ocher, olive, and light red. This material may have a weakly developed subangular nut structure, but it is easily crushed to a soft crumby yellow mass. Fifty percent or more of the volume of material is angular chert fragments. Soft black concretions may be plentiful in places. This material is heavier in texture with increasing depth, and the quantity of red coloration increases. Cherty dolomite bedrock is at a depth of 30 to 100 feet; pH, 4.0 to 4.5.

Where the soil is cleared, especially on the steeper slopes, nearly all of the fine soil material of the A horizon may be missing because of loss through accelerated erosion.

SEQUOIA SERIES

The Sequoia soil is developed from parent material weathered from interbedded limestone and shale under a mixed forest of hardwoods and pines. It has undulating to rolling slopes; is well drained externally, but internal drainage may be somewhat slow because of the shallow depth to bedrock and the heavy texture of the lower layers; and is geographically associated with the Armuchee soils.

The parent material of the Sequoia soil is similar to that of the Armuchee soils, the chief differences being due to differences in relief. The Armuchee soils are on steep and hilly relief so that geologic erosion proceeds at a rate so rapid that a distinct soil profile cannot form, whereas the Sequoia soil is on relatively gentle relief and normal soil-forming processes produce a soil with zonal characteristics. In some respects the Sequoia soil is similar to those of the Talbott series, the chief differences probably being due to the differences in lime content of the parent materials. It is likely that the more acid character of the parent material of the Sequoia soil is responsible for the development of a Yellow Podzolic profile rather than a Red Podzolic one similar to that of the Talbott soils. In fact, locally, small areas of Red Podzolic soils very similar to the Talbott soils are included with the

Sequoia soil as it is mapped in the county, and in other places, the soil has a reddish-yellow color intermediate between that of a typical Red Podzolic soil and a Yellow Podzolic one.

HARTSELLS SERIES

The Hartsells series includes a soil with fairly well-developed Yellow Podzolic profile developed from massive, level-bedded acid sandstone containing some layers of shale in places on the broader rolling mountain crests on Cumberland Mountain. The native vegetation consists chiefly of hardwoods. The climate is similar to that under which other zonal soils of the county were formed, although temperatures may average slightly less and rainfall slightly more because of the higher elevation. The light texture of the soil permits rapid water movement and thorough aeration, and slightly different internal climate might be expected for the Hartsells soil than some of the zonal soils developed from heavier materials.

The sandstone from which the Hartsells soil is derived weathers very slowly and geologic erosion proceeds at a rather rapid rate in the mountainous terrain so only relatively thin soil profiles develop. This coarse-textured material permits rapid leaching, and the low original supply of bases is soon removed so that the soil is very low in these constituents. Rather distinct color differentiation of the soil horizons is evident, but textural profiles are weakly developed, largely because of the very low content of the finer soil separates (clay) in the parent material. The B horizon, however, is consistently heavier in texture than the A horizon even though both may be classified as fine sandy loams.

Following is a description of a profile of Hartsells stony fine sandy loam under virgin conditions:

- A₁. 0 to 1 inch, gray friable fine sandy loam containing a moderate quantity of well-decomposed organic matter. This layer is heavily matted with tree rootlets and contains small sandstone fragments; strongly acid in reaction.
- A₂. 1 to 6 inches, grayish-yellow very friable fine sandy loam containing a moderate quantity of sandstone fragments. This layer contains many tree rootlets; is low in organic matter; and is strongly to very strongly acid in reaction.
- B. 6 to 18 inches, pale-yellow heavy fine sandy loam to fine sandy clay loam. This material may break into indistinct nuciform aggregates, but these particles are very weakly formed, and the material crushes easily to a soft friable mass. This layer contains a relatively large quantity of sandstone fragments and is very strongly acid in reaction.
- C. 18 to 32 inches, yellow friable fine sandy loam splotched with shades of yellow, yellowish brown, and brown. This layer contains a large quantity of angular sandstone fragments and is underlain by horizontally bedded massive acid sandstone. The lower few inches is lighter in texture and is profusely mottled with shades of light yellow and gray.

Where the soil is cleared the A₁ and A₂ horizons are mixed and a part of the material has been lost through erosion.

HOLSTON SERIES

The soil of the Holston series has developed from old stream alluvium derived chiefly from sandstone and shale. It has gently to strongly sloping relief, good external drainage, and adequate but

slightly restricted internal drainage; it is a very old soil and in some places approaches the Planosols in soil properties.

Like other Yellow Podzolic soils, it is developed from material low in bases, a condition that likely promotes rapid soil formation. Slightly restricted internal drainage may also have contributed to the yellow color, which is in contrast to the red color of the well-drained Waynesboro soil developed from similar material.

The following is a profile description of Holston fine sandy loam:

- A₁. 0 to 1 inch, brownish-gray loose open fine sandy loam stained with organic matter; pH, about 6.0.
- A₂. 1 to 8 inches, gray to yellowish-gray loose open light fine sandy loam with no definite structural development and relatively low in humus; pH, 5.0 to 5.5.
- A₃. 8 to 14 inches, light-yellow friable but slightly firm loam or fine sandy loam, containing minglings and streaks of gray that have sifted from the A₂ layer. It has no definite structure and when disrupted crushes to an incoherent loose yellow mass; pH, 4.5 to 5.0.
- B₂. 14 to 30 inches, brownish-yellow clay loam that is somewhat firm in place; moderately brittle and breaks into subangular nutlike aggregates easily crushed to a smooth friable mass when moist; when dry they are somewhat hard. The structural particles are covered with glossy yellow and brown coating in some places; pH, 4.0 to 4.5.
- C. 30 to 45 inches, brownish-yellow sandy clay mottled with gray, yellow, red, and brown. This material generally has no definite structure, and when disrupted consists of a loose friable mass; layers of sand, gravel, and silt are commonly in the lower part; pH, 4.0 to 4.5.

Where the soil is cleared the A₁ and A₂ horizons are mixed; and on the more sloping parts, some of this surface layer may have been removed by accelerated erosion.

SEQUATCHIE SERIES

The soils of the Sequatchie series are on low-terrace lands or second bottoms along the larger creeks and rivers. They are developed on nearly level to gently sloping relief from parent material similar to that of the Pope soil with which they are generally closely associated geographically. They developed also under a hardwood forest. The materials from which some of the soils are derived have not been in place so long as those of most of the zonal soils and horizon differentiation is not extremely striking. In some places, however, the soils have fairly well-developed profiles and are classified as Yellow Podzolic soils.

Following is a description of Sequatchie fine sandy loam:

- A₁. 0 to 12 inches, grayish-brown friable mellow fine sandy loam. In the virgin profile the upper 2 inches is darkened by organic matter; pH, 5.0 to 5.5.
- B₂. 12 to 30 inches, yellow-brown friable light fine sandy clay loam to clay loam that generally breaks into an incoherent granular mass although in places it might have an indistinctly developed weak nut structure. It may contain some sandstone fragments in the lower part; pH, 4.5 to 5.0.
- C. 30 to 48 inches, light-brown to light reddish-brown fine sandy loam to fine sandy clay loam containing some sandstone gravel and cobbles. The underlying sandy alluvium is dominantly yellow or light brown in color and contains beds of gravel and cobbles. It is many feet thick and is underlain in most places by limestone or dolomite.

JEFFERSON SERIES

The soils of the Jefferson series are on foot slopes and benches at the base of long slopes. Their parent material is mostly rather old local

alluvium and colluvium washed chiefly from the Muskingum soils on the adjoining uplands, although locally some material from Lehew and Montevallo soils may be included. The Jefferson soils have gently to strongly sloping relief and are well drained. They developed under mixed forest of hardwood, pine, and hemlock. The climate is essentially the same as that of the other zonal soils of the county. In some places these soils receive some increments of soil material, and they are not so well developed as are some of the zonal soils. The materials, however, are low in bases and easily eluviated; so, in most places, rather distinct Yellow Podzolic profiles are developed.

Following is a description of Jefferson stony fine sandy loam:

- A. 0 to 1 inch, gray loose fine sandy loam containing a moderate quantity of organic matter and heavily matted with tree rootlets; pH, 4.5 to 5.0.
- A₂. 1 to 8 inches, light grayish-yellow friable fine sandy loam with a weak fine-crumb structure containing a large quantity of sandstone fragments and quartz pebbles.
- B₂. 8 to 30 inches, brownish-yellow to yellow friable sandy clay loam, friable when moist but when dry slightly brittle, shattering to an incoherent yellow mass. It contains angular sandstone fragments and quartz pebbles; pH, 4.0 to 4.5.
- C. 30 to 40 inches, yellow fine sandy clay mottled with yellow, gray, and brown containing a large quantity of angular sandstone fragments. It is rather firm in place but is easily crushed to a loose mass when removed.

Material similar to the layer above continues to a depth of several feet and is underlain in most places by sandstone bedrock.

LEADVALE SERIES

The soils of the Leadvale series are on foot slopes, fans, and benches at the foot of steep slopes closely associated with the Montevallo soils geographically, and their parent material consists chiefly of colluvium and local alluvium from those soils, although locally Lehew and Armuchee soils have contributed some material. These soils have gently sloping to sloping relief; but because of the silty character of the parent material, they are somewhat imperfectly drained. They were formed under hardwood forests under climatic conditions similar to those under which the other zonal soils were developed. In some places these soils are still receiving some increments of soil material, and in places this has tended to retard profile development. But the greater part of the alluvium from which these soils have developed was deposited by geologic erosion, and in general the Leadvale soils are properly classified as Yellow Podzolic soils.

Following is a profile description of Leadvale silt loam:

- A₂. 0 to 10 inches, light grayish-brown friable heavy silt loam. In the virgin profile the upper inch or two is darkened by humus. This layer contains a few small fragments of sandstone and shale that crushes to a smooth soft grayish-yellow mass; pH, about 5.0.
- B₂. 10 to 24 inches, yellow moderately friable silty clay loam with a weakly developed subangular nut structure. This material crushes to a smooth soft yellow fine granular or crumbly mass containing some small black concretions and is faintly mottled in the lower part; pH, 4.5 to 5.0.
- C. 24 to 60 inches, yellow light silty clay loam containing streaks and mottlings of bluish gray, ocher, and brown. This material is somewhat brittle in place but when disrupted it breaks into subangular aggregates that are easily crushed. The quantity of mottlings increases with depth.

The underlying material is similar to the above layer and extends to a depth of several feet in most places. It is underlain by shale bed-rock or interbedded shale and limestone.

Variations from this profile are due to differences in sources of parent material, age, and on the stronger slopes, to accelerated erosion.

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, and developed on a nearly flat upland surface under grass or forest vegetation in a humid or subhumid climate (6).

Soils of four series—Monongahela, Tyler, Taft, and Robertsville—have been designated as Planosols. The soils of these four series have nearly level or slightly depressional relief and are imperfectly or poorly drained. All have a B horizon that is more dense or compacted than in most zonal soils, but its degree of development varies in the four series.

Climatic conditions are similar to those under which the zonal soils developed, but internal climate is more moist and less well aerated much of the time than in the zonal soils. The kinds of vegetation on the Planosols and on the Red or Yellow Podzolic soils differ somewhat, although deciduous forest is on both. From the standpoint of profile development the Planosols are older than the Red or Yellow Podzolic soils, but the causes of development of older soils are not known. The relief is such that geologic erosion would be slow, but that factor alone is not the cause of their formation. The material itself is not older in years than that of associated zonal soils of similar relief. It is possible that relatively dense layers in the parent material and underlying rock strata caused slow internal drainage, which, combined with slow external drainage and unusual siltiness of parent material, resulted in abnormal concentration or cementation of the material in or below the illuvial horizon.

MONONGAHELA SERIES

The soil of the Monongahela series closely resembles that of the Taft series, and the chief differences between the two are incident to the differences in parent material. The Monongahela soil is on nearly level low terraces underlain by alluvium washed chiefly from shale and sandstone materials similar to those underlying the Holston soil. Climate and general vegetative cover on the two soils are essentially the same but the Monongahela is generally on more gentle relief and has poorer external and internal drainage. Most of it is underlain at shallow depths by thin-bedded shale through which water percolates very slowly, which is largely responsible for the imperfect internal drainage of the soil.

The following is a description of a virgin profile of Monongahela silt loam as developed in the county:

- A₁. 0 to 1 inch, gray silt loam stained with organic matter.
- A₂. 1 to 8 inches, light-gray friable silt loam. When dry this material is somewhat brittle, but it is easily crushed to an almost white powdery mass; pH, about 5.0.
- B₂. 8 to 20 inches, bright-yellow silty clay loam somewhat compact in place; when disrupted it is moderately sticky and plastic; has a coarse nut

structure; in places contains some brown mottlings and soft-brown concretions; pH, 4.5 to 5.0.

- X. 20 to 30 inches, gray to bluish-gray silty clay mottled with yellow and brown and containing some concretions. This material is very firm and compact in place; when disrupted it breaks into large irregular-shaped lumps. The underlying stream alluvium is grayish silty material derived chiefly from acid shale. In most places it is underlain at rather shallow depths by acid fissile shale; pH, about 4.5.

Most of this soil is cleared and cultivated and as a result the A_1 and A_2 layers are mixed and most of the original organic matter has been dissipated. No accelerated erosion is apparent.

TYLER SERIES

The soil of the Tyler series is on level or slightly depressed parts of low terraces underlain by sandstone and shale materials. It is geographically associated with the Monongahela soil and bears the same morphological relation to it that the Robertsville soil does to the Taft. The Tyler soil is poorly drained both internally and externally owing to level slopes, to the silty character of the soil material, and to the impervious nature of the underlying rocks.

Following is a description of Tyler silt loam :

- A_1 . 0 to 2 inches, gray silt loam stained with organic matter. This layer contains many rootlets and fragments of partly decomposed plant remains.
- A_2 . 2 to 6 inches, light yellowish-gray floury silt loam.
- A_3 . 6 to 14 inches, yellowish-gray silt loam mottled with brown, yellow, and red. This layer contains soft brown concretions; mottlings and concretions are in old root channels, and old partly decayed roots are numerous.
- X. 14 to 28 inches, heavy compact gray silty clay containing yellow and brown mottlings. When disrupted this material breaks into large firm lumps. Root casts and concretions persist in this layer.

The underlying alluvium is heavy gray material washed largely from acid shale. In most places it is underlain at a shallow depth by acid shale. Most of the soil is now cleared and the upper layers of the soil have been mixed.

TAFT SERIES

The soil of the Taft series is on nearly level or level positions on low terraces. It is underlain by old stream alluvium washed chiefly from limestone material with some shale influence in most places. External climate and general vegetative cover are similar to that of the Etowah soil, but the Taft is on more gentle relief and has poorer internal and external drainage. It is underlain at a shallow depth by nearly level-bedded or gently dipping massive limestone which, together with the fine texture of the parent material, is largely responsible for the imperfect drainage.

Following is a description of a virgin profile of Taft silt loam :

- A_1 . 0 to 1 inch, loose gray silt loam stained with organic matter and heavily matted with tree rootlets.
- A_2 . 1 to 8 inches, loose friable light-gray light silt loam with no definite structure. When dry this material is rather brittle in consistence; pH, about 5.0.
- A_3 . 8 to 14 inches, light grayish-yellow moderately friable silt loam. When dry this material breaks into large irregular-shaped porous moderately brittle aggregates that can be crushed to a fine powdery mass; pH, about 5.0.

- B₂. 14 to 18 inches, light brownish-yellow silty clay loam faintly mottled with gray. This material is moderately sticky and plastic when wet and somewhat hard and brittle when dry; when moist it crumbles to a fine crumby mass; pH, about 4.5.
- B₃. 18 to 30 inches, bright-yellow silty clay loam compact in place but when disrupted it is moderately easily crumbled to angular nutlike aggregates; pH, about 4.5.
- X₁. 30 to 42 inches, brownish-yellow silty clay mottled with gray, red, and shades of brown. This material is sticky, plastic, and tough when wet; when dry it breaks into rather large hard lumps; pH, about 4.5.
- X₂. 42 to 50 inches, bluish-gray heavy sticky plastic silty clay compact in places and breaking into large lumps when disrupted.

Limestone residuum or limestone bedrock is at rather shallow depths below this soil.

At present most of the soil is cleared and the A_1 horizon is mixed with the A_2 , but in no place has a significant quantity of this surface layer been lost through accelerated erosion.

ROBERTSVILLE SERIES

The soil of the Robertsville series is developed from old limestone alluvium similar to that giving rise to the Taft soil. It is on nearly level or depressed positions on low terraces. Both internal and external drainage are very slow. The general type of vegetation and parent material is similar to that of the Taft soil. The poorer drainage, which results in differences in internal climate and in conditions for biological activity, is chiefly responsible for the difference between this soil and that of the Taft series.

Following is a description of Robertsville clay loam profile:

- A₁. 0 to 2 inches, gray silt loam stained with organic matter and heavily matted with rootlets; pH, about 5.5.
- A₂. 2 to 6 inches, light-gray to almost white clay loam containing yellow and brown mottlings and some brown concretions. This material is rather loose and floury when dry but moderately sticky when wet; pH, 4.5 to 5.0.
- X. 6 to 24 inches, heavy gray silty clay containing mottlings of yellow and ochre and brown concretions. When wet this material is sticky and plastic and when dry hard and intractable; pH, about 4.5.
- C. Old stream alluvium derived from limestone material that is ordinarily heavy in texture and dominantly gray in color.

At present practically all this soil is cleared, and the upper layers are mixed. Little material has been lost from the surface by accelerated erosion.

LITHOSOLS

Lithosols are an azonal group of soils having no clearly expressed soil morphology and consisting of a freshly and imperfectly weathered mass of rock fragments largely confined to steeply sloping land (6). The positions occupied are such that geologic erosion is relatively rapid. The soils generally consist of rather easily eroded material. As a result, material is removed from the surface or mixed to an extent that soil-forming processes have not acted for a sufficient length of time on the soil material to produce well-defined genetic soil properties. As mapped, these soils include small areas of zonal soils.

Three land types mapped are man-made Lithosols. They are two kinds of Rough gullied land in which the true soil has been lost from most of the area by accelerated erosion induced by man's activities, and Mine dumps that consist of rock waste from mining operations.

COLBERT SERIES

The soil of the Colbert series is developed over residuum derived from the weathering of argillaceous limestone. It has undulating to rolling slopes and has developed under a mixed forest of hardwood and redcedar. The general climate is essentially the same as that under which other soils derived from limestone materials developed.

The Colbert soil is shallow over bedrock and has a weakly developed or indistinct profile. The lack of profile development in other Lithosols is due chiefly to their strong slopes, whereas in this soil it is due to the resistance of the parent material to weathering and soil-forming processes. The parent materials are very heavy tenacious clays and prevent the normal circulation of moisture and air and probably impede the activities of soil micro-organisms so that leaching, translocation of soil materials, oxidation, and other chemical reactions do not proceed as in a normal soil, hence no true soil profile is developed. In some places in the Tennessee Valley soils classified in the Colbert series have weakly developed Yellow Podzolic profiles but as mapped in Claiborne County the soil is a true AC soil and is properly classified as a Lithosol.

ARMUCHEE SERIES

The soils of the Armuchee series are developed from residuum weathered from interbedded shale and limestone under a hardwood forest and under a climate similar to that of the zonal soils of the county. The Armuchee soils are shallow and do not have well-developed profiles. Their parent material is similar to that of the Yellow Podzolic Sequoia soil but because of the steep slopes and the erosive character of the material itself, it is removed by geologic erosion nearly as rapidly as it is formed so that a normal zonal soil profile cannot form, and the Armuchee soils are essentially AC soils.

Following is a description of Armuchee silt loam:

- A₁. 0 to 2 inches, dark grayish-brown silt loam with a fine granular structure. This material is heavily matted with rootlets and contains some small shale fragments; pH, 5.0 to 5.5.
- A₂. 2 to 12 inches, light-brown to yellowish-brown friable heavy silt loam that breaks into small subangular aggregates that are soft and easily crushed to a smooth yellowish-brown mass containing some small fragments of partly weathered olive-colored shale; pH, about 4.5.
- C. 12 to 28 inches, alternate layers of olive-colored blocky shale and brownish-red silty clay loam soil material somewhat mottled with yellow and brown and having a fairly well developed nut structure. The shale is soft and easily broken. The surfaces along the parting planes are coated with reddish or brownish glossy clayey material; pH, about 4.5.

The C layer rests on unaltered olive-colored blocky shale containing layers of gray limestone.

At present most of the soil is cleared and used for pasture so that the upper layers are mixed and in many places have been removed in part by accelerated erosion.

MONTEVALLO SERIES

The soils of the Montevallo series are developed from acid, fissile, variegated shale under a mixed forest of pine and hardwoods. They

have steep slopes and are developed under a climate that was in general essentially the same as that under which the zonal soils developed.

The Montevallo soils are very shallow over bedrock and do not have distinctly developed profiles. The underlying shale weathers slowly, and the resulting soil material is rather erosive which, together with the steep slopes, results in its removal by geologic erosion nearly as rapidly as it is formed. All these soils on steep slopes are true AC soils, but in a few places on milder slopes they have weakly developed shallow yellow Podzolic soils and might properly be designated as Lithosolic-Yellow Podzolic soils.

The following is a description of Montevallo shaly silt loam :

- A₁. Loose open silt loam containing a moderate quantity of fairly well incorporated organic matter. This layer is less than 1 inch thick; pH, about 5.0.
- A₂. ½ to 6 inches, light brownish-gray loose open friable silt loam containing small fragments of partly weathered yellow, green, purple, red, and gray shale; pH, about 4.5.
- C. 6 to 18 inches, a mixture of brownish-gray silt loam or silty clay loam soil material and green, yellow, red, purple, and gray shale. The proportion of shale is much larger than in the layer above and is less weathered.

The C layer rests directly on fissile acid shale bedrock. This shale is variegated in color in most places and includes yellow, red, purple, green, and gray shale and in some places black bituminous shale.

At present much of the soil is cleared and the upper layers are missing because of loss through accelerated erosion.

LEHEW SERIES

The soils of the LeheW series are developed from weathered residuum of purple, red, and green interbedded sandstone and shale under a mixed forest of pine and hardwoods under a climate essentially the same as that under which other Lithosols of the county are formed. Slopes are dominantly steep and very steep.

The rocks underlying the LeheW soils are resistant to weathering, and soil material forms slowly. Because of the steep slopes this material is removed by geologic erosion almost as rapidly as it is formed so that there is no accumulation of material on which a mature zonal soil can develop. As mapped, the LeheW soils are true Lithosols. The chief differences between these and the Muskingum soils are due to the differences in the color of the underlying rock; although, in general, the LeheW are on stronger slopes and have even less profile development than the Muskingum.

The following is a description of LeheW fine sandy loam :

- A₁. 0 to 1 inch, grayish-brown friable fine sandy loam containing some small fragments of purple, red, and gray shale. In places this material may have a purplish color. It is matted with fine tree rootlets.
- A₂. 1 to 8 inches, purplish-brown fine sandy loam containing small fragments of purple, red, and yellow partly weathered shale and fine-grained sandstone.
- C. 8 to 24 inches, a mixture of purple sandy soil material and fragments of red, purple, yellow, and green shale and fine-grained sandstone. The C layer rests directly on consolidated bedrock consisting of purple, red, and green shale interbedded with fine-grained sandstone of the same color. Locally thin beds of limestone are in the underlying rocks.

In many places the soil is cleared and the upper layers are mixed. In some places part of the upper layers may be missing because of loss through accelerated erosion.

MUSKINGUM SERIES

The soils of the Muskingum series are developed from material weathered from acid sandstone containing some layers of acid shale, chiefly under hardwood forests, although locally there may have been some pine. The soils are on the steep and hilly slopes of the mountains. In general, the climate is similar to that under which the zonal soils developed, although it is possible that because of the higher elevations, temperatures may be slightly lower and rainfall slightly higher than in other parts.

The sandstones underlying the Muskingum soils weather slowly so that parent material is formed slowly. On the steep slopes this material is removed by geologic erosion almost as rapidly as it is formed. Consequently, the Muskingum soils have thin, weakly developed profiles. As mapped, most of them do have weakly developed shallow Yellow Podzolic profiles; but because of their shallowness and weak development they are classified as Lithosols; although they probably are more correctly classified if designated as Lithosolic-Yellow Podzolic soils.

Following is a description of Muskingum stony fine sandy loam:

- A₀. About 1½ to 2 inches of undecomposed leaf litter from deciduous hardwood forests.
- A₁. Less than 1 inch of well-decomposed organic matter, very dark gray or black.
- A₁. 0 to 1½ inches, dark-gray loose fine sandy loam stained with organic matter; pH, about 5.0.
- A₂. 1½ to 8 inches, light grayish-yellow loose fine sandy loam that is low in organic matter. It has no definite structure and when disrupted consists of a loose incoherent mass; is heavily matted with tree rootlets; and contains angular sandstone fragments; pH, 4.0 to 4.5.
- B₂. 8 to 16 inches, brownish-yellow sandy clay that has a weakly developed nut structure. When disrupted it crushes easily into a soft friable pulverulent mass containing a large quantity of angular sandstone fragments. In many places this layer is very indistinctly developed or is entirely missing; pH, 4.0 to 4.5.
- C. 16 to 28 inches, fragments of partly weathered fine-grained sandstone or conglomerate in a matrix of brownish-yellow fine sandy clay. The soil material has no definite structural development and is mottled with gray, red, and brown; pH, about 4.0.
- D. 28 inches +, consolidated bedrock; massive fine-grained acid sandstone or conglomerate containing thin shale layers and in places extensive coal deposits.

ALLUVIAL SOILS

Alluvial soils are an azonal group of soils developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the material by soil-forming processes (6). In Claiborne County these soils are on first-bottom lands, along streams, in depressions, and on foot slopes. They have nearly level, gently sloping, and depressional relief, and good to very slow internal drainage. Their main properties in common are those related to a lack of a soil profile in which the horizons are genetically related. The properties of the soils are closely related to the alluvial deposit.

Alluvial soils derived from similar parent material may differ in the condition of drainage, and some differences in properties exist because of these drainage differences. Such soils have been differentiated mainly on the basis of properties associated with good, imperfect, or poor drainage and collectively they constitute a soil catena. Soils among the alluvial soils that have this catenary relationship are discussed in relation to their positions in soil catenae.

ROANE SERIES

The soil of the Roane series is developed on narrow bottom lands along small streams in the cherty ridges under hardwood forests. It is closely associated geographically with the Clarksville and Fullerton soils from which its parent material was washed. The Roane soil has nearly level slopes. It is a young soil generally higher in humus, phosphorus, and bases than the associated upland soils and varies in reaction depending on local differences in source of parent material, but is consistently less acid than the associated soils of the uplands.

The following is a description of Roan silt loam:

1. Brown to grayish-brown friable silt loam 10 to 24 inches thick. In the virgin condition this layer is stained dark with organic matter in the upper 2 or 3 inches and is heavily matted with rootlets. It generally contains a small or moderate quantity of fine chert fragments.
2. A firm compacted or cemented layer consisting of small chert fragments and brownish clayey soil materials. This layer contains some gray and yellow mottlings. When disrupted this material is a loose mass of chert fragments and soil material that ranges in thickness from a few inches to nearly 2 feet. The factors responsible for the formation of this layer are not known.
3. Silty stream alluvium containing much chert.

LINDSIDE AND MELVIN SERIES

The soils of the Lindside and Melvin series are the imperfectly and poorly drained members of a catena of soils developed on first-bottom lands and derived from young stream alluvium washed chiefly from limestone material. The Huntington soil, the well-drained member of the catena, is not found in Claiborne County. All these soils have nearly level relief. They were formed under hardwood forests, the specific association of trees varying somewhat among the different soil series depending upon differences in drainage. All these soils are young and do not have developed profiles. In general they are higher in bases, phosphorus, nitrogen, and humus than are the associated zonal soils of the uplands and terrace lands.

The upper 18 inches of the Lindside soil is typically a grayish-brown mellow friable heavy silt loam containing a few fragments of chert or gravel. The upper inch or two of the virgin profile is stained dark with organic matter. This surface layer is underlain by a gray silty clay mottled with ocher, red, and dark gray and contains some soft black and brown concretions. The mottlings and concretions follow old root channels. The underlying alluvium is typically mottled clays containing some chert or gravel beds. The gray layer of this soil is saturated with water through much of the year. In some respects it is gleilike and it has been suggested that the Lindside soil be designated as an alluvial soil with a glei horizon.

The 6- or 8-inch surface layer of the Melvin soil is light-brown silt loam containing gray mottlings. It is underlain by gray silty clay loam heavily mottled with brown and ocher. Both of these layers commonly contain partly decomposed fragments of plant residues. The underlying alluvium is similar to that of the Lindsides soil. As with the Lindsides soil the mottled layer resembles glei and the Melvin soil might be properly designated as an alluvial soil with a glei horizon.

DUNNING SERIES

The soil of the Dunning series is developed on first-bottom lands from stream alluvium that washed chiefly from argillaceous limestone with some shale influence in places. It has nearly level slopes and was formed under hardwood forests. It is a young soil and does not have a distinct genetic profile. The dark color of the surface soil is believed to be due to its high content of organic matter. The high lime content of the soil and its parent material together with other factors created conditions favorable for the formation and preservation of a large quantity of humus.

The following is a description of Dunning silty clay loam:

- A. 0 to 12 inches, dark-gray to almost black heavy silty clay loam that is sticky and plastic when wet and hard and intractable when dry. When moist it breaks into large firm nutlike aggregates. In some places structure particles may be thinly coated with gray or yellow colloidal material, and faint-gray and yellow mottlings are common in the lower part of the layer; pH, 6.0 to 7.0.
- C. 12 to 36 inches, gray to bluish-gray heavy tough sticky plastic silty clay mottled with brown and yellow. Soft, red and yellow concretions and black mottlings are common in the lower part. In places thin layers of sand or gravel may be present. This layer is somewhat variable in thickness. In most places it is underlain by massive limestone bedrock; pH, 6.0 to 7.0.

POPE, PHILO, AND ATKINS SERIES

The Pope, Philo, and Atkins are a catena of soils on first-bottom lands developed from alluvium washed chiefly from acid sandstone and shale. They are closely associated geographically with the Muskingum, Montevallo, and Lehew soils; have nearly level slopes; and were developed under hardwood forests; the association of forest trees varying somewhat among the soils of the different series due to drainage differences. They are young soils and do not have distinct genetic profiles; differ from the Huntington, Lindsides, and Melvin soils in being derived chiefly from material washed from acid rocks rather than from limestone; and are generally lighter in texture and color, more acid, and lower in bases, phosphorus, and nitrogen than the soils of the Huntington catena. They are, however, more favorable in these respects than are the associated soils in the uplands.

The Pope soils are the well-drained member of the catena. The 10- to 12-inch surface layer is grayish-brown fine sandy loam. In the virgin profile the upper 2 or 3 inches are stained with organic matter. This layer is underlain by brownish-yellow to yellow fine sandy loam. Below a depth of 3 feet this material may contain some gray mottlings. The underlying alluvium is somewhat stratified and may contain beds of coarse sand, gravel, and some silt. In most places this alluvium is many feet thick and is underlain by sandstone bedrock.

The Philo soils are imperfectly drained. The 10- to 15-inch surface layer is typically brownish-gray friable fine sandy loam. In many places this layer is stony or gravelly and is underlain by gray fine sandy loam heavily mottled with yellow and brown. The underlying alluvium is similar to that of the Pope soil. The gray subsoil layer is saturated with moisture in all but the driest seasons of the year. In some respects it is gleilike. It has been suggested that the Philo soils be designated as alluvial soils with a glei horizon.

The Atkins soil is poorly drained. It generally contains a larger proportion of silty materials than do the other soils of the catena, which together with the depressed position of the soil likely accounts for its poorer drainage. The surface few inches are light-gray silt loam or fine sandy loam mottled with brown and yellow. The underlying layer is generally heavier in texture, less friable, more gray or bluish in color, and more heavily mottled. The underlying alluvium is similar to that under the Pope and Philo soils, although it may contain more silt and clay. As with the Philo soils the mottled layer in this soil resembles glei, and it is suggested that it be classified as alluvial soils with a glei horizon.

EMORY SERIES

The soil of the Emory series is along foot slopes and benches at the base of high hills, chiefly along small intermittent streams. It was developed from local alluvium and colluvium washed from Bolton, Claiborne, and Dewey soils with which it is closely associated geographically and under hardwood forests under a climate similar to that under which the associated zonal soils were formed, but its material was so recently deposited that soil-forming processes have not had time to act and no genetic profile has developed. It has nearly level to gently sloping relief. In parts of the Tennessee Valley soils from similar materials in similar positions have fairly well developed profiles and are classified as Red Podzolic soils; but as mapped in Claiborne County, the Emory soil is so young that it is included with the alluvial soils.

Following is a description of Emory silt loam :

1. 0 to 12 inches, rich-brown friable mellow heavy silt loam with a fine-crumb structure. In many places this has a very recent accumulation of material washed from the adjoining upland slopes. In the virgin soil the upper 2 or 3 inches is darkened with humus; pH, 6.0 to 6.5.
2. 12 to 30 inches, dark yellowish-brown heavy silt loam; mellow and friable in consistence and having a crumb or fine granular structure. Small dark-brown concretions similar to those in the B horizon of the Bolton soils are numerous in the lower part of this layer.
3. 30 to 48 inches, brown, yellowish-brown, or reddish-brown moderately friable heavy silt loam containing some small chert fragments and numerous concretions similar to those in the layer above. The underlying colluvial and alluvial materials, generally dolomite, are similar to this layer and extend to depths of many feet.

GREENDALE SERIES

The soils of the Greendale series are on foot slopes at the base of hills along intermittent streams and in the bottoms of large lime sinks. Their parent material consists of local alluvium and colluvium washed from the Fullerton and Clarksville soils on the adjoining upland slopes. They were developed on nearly level to sloping relief under

a hardwood forest, and the climate was essentially the same as that under which the associated zonal soils were formed. The materials from which the Greendale soils are formed were recently deposited, and, in most places, there are frequent additions of material to the soil from adjoining upland slopes. As a result the soil is young and generally has little profile development. In some parts of the Tennessee Valley soils included in the Greendale series have rather distinct, though young, genetic profiles and are classified as Yellow Podzolic soils.¹⁵ In Claiborne County, however, nearly all of these soils are so young and have such indistinct or weakly developed profile that they are more correctly classified if they are included in the alluvial soils.

Following is a description of Greendale silt loam:

1. 0 to 10 inches, gray to grayish-yellow loose upon friable silt loam. In the virgin profile the upper 1 or 2 inches is darkened with organic matter and contains small angular chert fragments; acid in reaction.
2. 10 to 24 inches, light brownish-yellow to yellow moderately friable light silty clay loam containing some minglings of gray from the overlying layer. It breaks into small soft subangular aggregates containing a considerable quantity of angular chert fragments; strongly acid in reaction.
3. 24 to 40 inches, yellow light silty clay loam containing 50 percent or more of angular chert fragments. It is somewhat firm in place but when disrupted it crumbles to a loose incoherent mass. In places it may be mottled with gray and brown. The underlying colluvial deposits are a mixture of yellow to light-brown soil material and angular chert fragments extending to depths of many feet and are generally underlain by cherty dolomite bedrock; strongly acid in reaction.

OOLTEWAH SERIES

The soil of the Ooltewah series is chiefly in shallow depressions in uplands underlain by limestone. The parent material is derived from local alluvium and colluvium washed chiefly from Talbott and Dewey soils, although Fullerton and Clarksville soils contribute some materials in places. The Ooltewah soil developed under a hardwood forest, and the climate is essentially the same as that under which the associated zonal soils are formed. The Ooltewah receives frequent increments of soil material from the adjoining upland slopes; and as a result material accumulates more rapidly than soil-forming processes can act. This soil is therefore a young soil with no genetic profile. It is imperfectly drained and has a gray mottled layer that is gleilike in some of its properties, and it is suggested that it be designated as an alluvial soil with a glei horizon.

Following is a description of Ooltewah silt loam:

1. 0 to 15 inches, light-brown to yellowish-brown moderately friable heavy silt loam with a crumb or fine granular structure. Faint-gray mottlings are in the lower part of this layer. In the virgin profile the upper few inches are darkened with humus; pH, 5.0 to 5.5.
2. 15 to 40 inches, gray silty clay loam mottled with brown, yellow, and red. This layer contains numerous soft-red and brown concretions; some-

¹⁵ After the Claiborne County survey was completed the Pace series was proposed to include the soils derived from colluvium from cherty limestone that have well-developed Yellow Podzolic profiles. It is likely that a small part of the soils included in the Greendale series in Claiborne County would now be classified in the Pace series, but most of them are young soils without well-defined genetic profiles.

what sticky and plastic when wet but moderately friable when moist and crumbling to a soft granular mass ; pH, 4.5 to 5.0.

The underlying colluvial material is dominantly gray silty clay loam mottled with yellow and brown. It contains some chert fragments in places and is underlain at depths of several feet by limestone bedrock.

GUTHRIE SERIES

The soil of the Guthrie series is in small depressions in uplands underlain by limestone. Its parent material is local alluvium and colluvium washed chiefly from Dewey and Talbott soils, but Clarksville and Fullerton soils contribute some material in places. Because of the depressed position this soil is poorly drained. It developed under hardwood forests under a climate essentially the same as that under which the associated zonal soils were formed. It receives frequent increments of soil material from the adjoining uplands and is a young soil without a genetic profile. The true Guthrie soil of the Highland Rim section of Tennessee is an old poorly drained Planosol on uplands underlain by cherty limestone. The soil of Claiborne County classified in this series is similar insofar as drainage and parent rock are concerned, but it is a young soil and its morphology and genesis differ from those of the true Guthrie soil.

Following is a description of Guthrie silt loam :

- 1 0 to 12 inches, light yellowish-gray heavy silt loam mottled with yellow, brown, and ocher. It contains some small dark-brown hard concretions and many fragments of partly decomposed plant residues. Most of the mottlings are in old root channels.
2. 12 to 36 inches, gray silty clay containing mottlings of ocher and brown. The material is sticky and tenacious and when disrupted breaks into large lumps. Partly decomposed plant remains are plentiful, and the layer may continue with some variations to depths of several feet ; it is underlain by limestone bedrock.

LAND TYPES

STONY LAND (TALBOTT SOIL MATERIAL)

Stony land (Talbott soil material) is underlain by limestone and dolomite. It has slopes ranging from undulating to steep. The original vegetation consisted of redcedar and hardwoods. The climate was essentially the same as on that under which the zonal soils of the county were developed. On this land type geologic erosion has kept pace with rock weathering so that soil material is removed as rapidly as it is formed. The erosive character of the material itself and the strong slopes are among the factors responsible for the formation of this kind of land.

Inasmuch as this type of land is not a true soil, considerable variations in properties are found. It is, however, essentially low limestone bedrock outcrops with intervening strips of soil material. The character of the soil material varies according to the composition of the associated rocks. Where the rocks are relatively pure or slightly cherty limestone, the material is similar to that of either the Talbott or Dewey soils ; where the rocks are dolomites the soil material is more like that of the Fullerton series. In general the proportion of outcrop is greater on the stronger slopes but this is not consistently true.

STONY LAND (MUSKINGUM SOIL MATERIAL)

Stony land (Muskingum soil material) is on hilly and steep mountain slopes underlain by acid sandstone and conglomerate. The original vegetation consisted of scrubby forests of pine and hardwoods. Climatic conditions were similar to those under which the zonal soils developed. Severe folding of the underlying rocks, their resistance to weathering, rapid removal of the soil material by geologic erosion, and steep slopes are among the factors that contribute to the formation of this kind of land.

In some respects this land resembles Stony land (Talbot soil material), the chief differences being due to differences in the kind of underlying rock. This land consists largely of large outcrops and boulders of sandstone or conglomerate with small quantities of sandy soil material accumulated in places. It includes areas of large sandstone cliffs and escarpments.

STONY COLLUVIUM (MUSKINGUM SOIL MATERIAL)

Stony colluvium (Muskingum soil material) is on slopes at the foot of mountains and in the beds of some of the mountain streams. It consists essentially of accumulations of sandstone rock fragments and because of the recent time of deposition and the resistance of the materials to weathering, no soils have formed. Most of the material is so low in fertility that no form of vegetation can grow, which is another factor that prevents soils from forming.

LIMESTONE ROCKLAND

Limestone rockland is similar to Stony land (Talbot soil material) and differs from it chiefly in that the proportion of outcrops is greater and the outcrops protrude farther above the ground and are more jagged and rugged. The proportion of the land area covered with soil material is much smaller and in most places resembles the Colbert rather than the Talbot soils. The differences between these two types of land are partly due to differences in the associated rocks. Most of it is on argillaceous limestone which upon weathering yields clayey materials that are very erosive and are therefore almost entirely removed by geologic erosion as soon as they are formed. Strong slopes and folding of the rocks are other factors that have contributed to the formation of this kind of land.

ROUGH GULLIED LAND

Rough gullied land is a man-made Lithosol. It is formed because of improper land use and management and consists of land that has been reduced to a network of gullies by accelerated soil erosion. Rough gullied land (Talbot soil material) includes areas of land that were originally covered with soils derived from limestone material that has been reduced to a network of gullies, whereas Rough gullied land (Montevallo soil material) includes lands that were originally covered with soils derived from acid shale.

MINE DUMPS

Mine dumps is a man-made Lithosol consisting of large piles of shale and other refuse from mining operations that have been dumped near the openings of coal-mine shafts.

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SUPPLEMENT TO THE SOIL MAP OF CLAIRBORNE COUNTY, TENNESSEE, SHOWING PRINCIPAL CHARACTERISTICS OF THE SOILS

Soil (type, phase, complex, or land type)	Map symbol	Group (according to legend of soil map)	Parent material	Topography	Internal drainage	Surface soil color	Subsoil		Use suitability group
							Color	Consistence	
Allen loam.....	Al.....	Soils of sloping colluvial lands.....	Old colluvium and local alluvium chiefly from acid sandstone and shale.	Rolling.....	Moderate.....	Grayish brown to brown	Yellowish red to red.....	Moderately friable.....	2
Alluvial soils, undifferentiated..	A.....	Soils of imperfectly drained stream bottom lands.	Young stream alluvium chiefly from cherty dolomite and limestone, some from shale and sandstone.	Nearly level.....	Slow to moderate.....	Grayish brown.....	Gray.....	do.....	4
Armuchee silt loam.....	Am.....	Soils of steep hilly lower slopes underlain chiefly by limestones and calcareous shales.	Residuum from weathering of interbedded limestone and shale.	Hilly.....	Moderate.....	Light brown or yellowish brown.	Brownish red or yellowish red.	Plastic, sticky.....	4
Steep phase.....	Amz.....	do.....	do.....	Steep.....	do.....	Grayish brown to light brown.	do.....	do.....	4
Atkins silt loam.....	Ak.....	Soils of poorly drained stream bottom land.	Young stream alluvium washed from acid sandstone and shale.	Level.....	Very slow.....	Gray mottled with brown and yellow.	Gray or bluish gray mottled with brown and yellow.	Moderately plastic.....	4
Bolton silt loam.....	Bt.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	Residuum from weathering of sandy cherty dolomite.	Hilly.....	Moderate.....	Dark reddish brown.....	Dark red.....	Friable.....	3
Rolling phase.....	Bto.....	Soils of rolling ridge tops underlain by cherty dolomites.	do.....	Rolling.....	do.....	do.....	do.....	Moderately friable.....	2
Steep phase.....	Btz.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	do.....	Steep.....	do.....	Reddish brown.....	Red.....	do.....	4
Caylor silt loam.....	Cr.....	Soils of sloping colluvial lands.....	Old colluvium and local alluvium from limestone, calcareous shale, and acid sandstone.	Sloping.....	do.....	Light brown.....	Yellowish brown.....	do.....	2
Gently sloping phase.....	Crg.....	Soils of gently sloping colluvial lands.	do.....	Gently sloping.....	do.....	Brown.....	do.....	do.....	1
Caylor stony silt loam.....	Cy.....	Soils of sloping colluvial lands.....	do.....	Sloping.....	do.....	do.....	do.....	do.....	2
Claiborne silt loam.....	Cn.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	Residuum from weathering of sandy cherty dolomite.	Hilly.....	do.....	Light brown.....	do.....	do.....	3
Rolling phase.....	Cno.....	Soils of rolling ridge tops underlain by cherty dolomites.	do.....	Rolling.....	do.....	do.....	do.....	do.....	2
Steep phase.....	Cnz.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	do.....	Steep.....	do.....	do.....	do.....	do.....	4
Clarksville cherty loam: Hilly phase.....	Cvl.....	do.....	do.....	Hilly.....	Rapid.....	Light gray or light brownish gray.	Yellow.....	Loose, brittle.....	4
Steep phase.....	Cvz.....	do.....	do.....	Steep.....	do.....	do.....	do.....	do.....	5
Clarksville cherty silt loam.....	Cc.....	Soils of rolling ridge tops underlain by cherty dolomites.	Residuum from weathering of cherty dolomite.	Rolling.....	Moderate.....	Light gray.....	Yellow or brownish yellow.	Firm, brittle.....	3
Hilly phase.....	Ccl.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	do.....	Hilly.....	do.....	do.....	do.....	do.....	4
Steep phase.....	Ccz.....	do.....	do.....	Steep.....	do.....	do.....	do.....	do.....	5
Clarksville loam.....	Ca.....	Soils of rolling ridge tops underlain by cherty dolomites.	Residuum from weathering of sandy cherty dolomite.	Rolling.....	do.....	Yellowish gray.....	do.....	do.....	3
Colbert silty clay loam, eroded phase.	Ctr.....	Soils of undulating and rolling slopes of upland troughs underlain chiefly by limestones.	Residuum from weathering of argillaceous limestone.	Undulating to rolling.	Slow.....	Gray or dark gray.....	Yellow or greenish yellow.	Compact, tenacious.....	4
Dewey cherty silt loam.....	De.....	do.....	Residuum from weathering of moderately cherty high calcic limestone.	do.....	Moderate.....	Grayish brown.....	Yellowish brown to yellowish red to red.	Sticky, plastic.....	2
Dewey silt loam.....	Ds.....	do.....	Residuum from weathering of high calcic limestone.	Undulating.....	do.....	Grayish brown or light brown.	Light red or red.....	do.....	1
Dewey silty clay loam: Eroded phase.....	Dwr.....	do.....	do.....	Rolling.....	do.....	Grayish brown.....	Yellowish red, red, or brownish red.	do.....	2
Eroded hilly phase.....	Dwt.....	Soils of hilly and steep slopes of upland troughs underlain chiefly by limestones.	do.....	Hilly.....	do.....	do.....	Light red, red, or brownish red.	do.....	3
Eroded steep phase.....	Dwf.....	do.....	do.....	Steep.....	do.....	do.....	Red.....	do.....	4
Dunning silty clay loam.....	Du.....	Soils of poorly drained stream bottom lands.	Young stream alluvium washed chiefly from argillaceous limestone material.	Level.....	Very slow.....	Nearly black.....	Gray mottled with yellow and brown.	do.....	4
Emory silt loam.....	Es.....	Soils of gently sloping colluvial lands.	Young local alluvium and colluvium chiefly from Dewey, Bolton, and Claiborne soils.	Gently sloping to sloping.	Moderate.....	Brown.....	Yellowish brown.....	Friable.....	1
Etowah silty clay loam, eroded phase.	Ecr.....	Soils of gently sloping well-drained stream terraces.	Old stream alluvium washed chiefly from limestone material.	do.....	do.....	Grayish brown or light brown.	Brownish red.....	Moderately plastic.....	2
Fullerton cherty loam.....	Fl.....	Soils of rolling ridge tops underlain by cherty dolomites.	Residuum from weathering of sandy cherty dolomite.	Rolling.....	Rapid.....	Gray.....	Light yellowish red.....	Firm but moderately friable.....	3
Hilly phase.....	Flh.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	do.....	Hilly.....	do.....	do.....	Yellowish red.....	do.....	4
Steep phase.....	Flz.....	do.....	do.....	Steep.....	Moderate.....	do.....	do.....	do.....	5
Fullerton cherty silt loam.....	Fc.....	Soils of rolling ridge tops underlain by cherty dolomites.	Residuum from weathering of cherty dolomite.	Rolling.....	do.....	do.....	Light yellowish red.....	Slightly plastic.....	3
Hilly phase.....	Fcl.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	do.....	Hilly.....	do.....	do.....	Yellowish red or light red.....	do.....	4
Steep phase.....	Fcz.....	do.....	do.....	Steep.....	do.....	do.....	do.....	do.....	5
Fullerton loam.....	Fm.....	Soils of rolling ridge tops underlain by cherty dolomites.	Residuum from weathering of sandy cherty dolomite.	Rolling.....	do.....	do.....	Yellowish red.....	Firm but moderately friable.....	2
Hilly phase.....	Fmh.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	do.....	Hilly.....	do.....	do.....	do.....	do.....	3
Steep phase.....	Fmz.....	do.....	do.....	Steep.....	do.....	do.....	do.....	do.....	4
Fullerton silt loam.....	Fs.....	Soils of rolling ridge tops underlain by cherty dolomites.	Residuum from weathering of cherty dolomite.	Rolling.....	do.....	Light brownish gray.....	Yellowish red or light red.....	Slightly plastic.....	2
Hilly phase.....	Fsl.....	Soils of hilly and steep ridge slopes underlain by cherty dolomites.	do.....	Hilly.....	do.....	Gray or brownish gray.....	do.....	do.....	3
Steep phase.....	Fsz.....	do.....	do.....	Steep.....	do.....	Gray.....	do.....	do.....	4
Greendale silt loam.....	Gr.....	Soils of gently sloping colluvial lands.	Moderately young to young local alluvium and colluvium washed chiefly from Fullerton and Clarksville soils.	Nearly level to gently sloping.	do.....	Gray or light grayish brown.	Light brownish yellow or yellow.	Friable.....	2
Sloping phase.....	Grx.....	Soils of sloping colluvial lands.....	do.....	Sloping.....	do.....	do.....	do.....	do.....	2
Guthrie silt loam.....	Gs.....	Soils of depressions and lime sinks.	Local alluvium and colluvium washed chiefly from limestone material.	Nearly level.....	Very slow.....	Gray or yellowish gray mottled with red and brown.	Yellowish gray mottled with red and brown.	Plastic.....	4
Hartsells stony fine sandy loam.....	Ha.....	Soils of rolling mountain crests underlain by acid sandstones and shales.	Residuum from weathering of acid sandstone and conglomerate.	Undulating.....	Moderate.....	Yellowish gray.....	Yellow.....	Moderately friable.....	3
Holston fine sandy loam.....	Ho.....	Soils of sloping well-drained stream terraces.	Old stream alluvium washed chiefly from acid shale and sandstone materials.	Nearly level to sloping.	Slow.....	Gray to grayish yellow.....	Yellow to brownish yellow.	Rather brittle.....	2
Jefferson stony fine sandy loam.....	Js.....	Soils of gently sloping colluvial lands.	Moderately young colluvium and local alluvium chiefly from acid sandstone material.	Gently sloping.....	Moderate.....	Gray or yellowish gray.....	Brownish yellow.....	Friable.....	3
Sloping phase.....	Jsx.....	Soils of sloping colluvial lands.....	do.....	Sloping.....	Rapid.....	do.....	do.....	Moderately friable.....	3
Leadvale silt loam.....	Ls.....	Soils of gently sloping colluvial lands.	Moderately young to old colluvium and local alluvium chiefly from acid shale material.	Nearly level to gently sloping.	Moderately slow.....	Light grayish brown or grayish yellow.	Yellow.....	do.....	2
Sloping phase.....	Lsx.....	Soils of sloping colluvial lands.....	do.....	Sloping.....	do.....	do.....	Yellow to light brownish yellow.	do.....	3
Lehew fine sandy loam.....	Lh.....	Soils of steep and hilly knobs and ridges underlain by acid shales and sandstones.	Residuum from weathering of interbedded acid sandstone and shale.	Steep.....	Rapid.....	Brown or purplish brown.	Brown or purplish brown with purple, red, and green.	Friable.....	5
Hilly phase.....	Lhl.....	do.....	do.....	Hilly.....	do.....	do.....	do.....	do.....	4
Limestone rockland (rolling)	Lr.....	Miscellaneous nonarable land types.....	Limestone bedrock.....	Gently to strongly rolling.	Moderate.....	Bedrock outcrop on 75 percent or more of the land surface, material similar to Colbert soil in intervening spaces.			5
Limestone rockland (rough)	Ld.....	do.....	do.....	Steep.....	do.....	do.....			5
Lindside silt loam.....	Ll.....	Soils of imperfectly drained stream bottom lands.	Young stream alluvium washed chiefly from limestone material.	Nearly level.....	Slow.....	Grayish brown or light brown.	Gray mottled with yellow and brown.	Moderately friable.....	2
Melvin silt loam.....	Ml.....	Soils of poorly drained stream bottom lands.	do.....	Level.....	Very slow.....	Gray mottled with brown.	Gray or bluish gray mottled with yellow and rust brown.	Friable to plastic.....	4
Mine dumps.....	Md.....	Miscellaneous nonarable land types.....	Acid shale and sandstone.....	Steep.....	Very rapid.....	Consists of piles of shale and other rock refuse from coal mines.....			5
Monongahela silt loam.....	Ms.....	Soils of level imperfectly drained stream terraces.	Old stream alluvium washed chiefly from acid shale and sandstone.	Nearly level.....	Slow.....	Grayish brown to gray.....	Yellow or brownish yellow.	Brittle.....	3
Montevallo shaly silt loam.....	Mv.....	Soils of steep and hilly knobs and ridges underlain by acid shales and sandstones.	Residuum from weathering of acid fissile shale.	Steep.....	Very rapid.....	Very shallow soil; 4-6 inches of brownish-gray shaly silt loam on shale bedrock.....			5
Hilly phase.....	Mvl.....	do.....	do.....	Hilly.....	Rapid.....	do.....			5
Muskingum stony fine sandy loam.	Mf.....	Soils of steep and hilly mountains underlain by acid sandstones and shales.	Residuum from weathering of acid sandstone and conglomerate.	Steep.....	do.....	Grayish yellow or yellow.....	Brownish yellow.....	Moderately friable.....	5
Deep phase.....	Mfd.....	do.....	do.....	Hilly.....	do.....	do.....	do.....	do.....	5
Ooltawah silt loam.....	Os.....	Soils of depressions and lime sinks.	Local alluvium and colluvium chiefly from limestone material.	Nearly level.....	Moderately slow.....	Light brown or grayish brown.	Gray mottled with yellow and brown.	Compact, sticky, and plastic.	2
Philo fine sandy loam.....	Pf.....	Soils of imperfectly drained stream bottom lands.	Young stream alluvium washed chiefly from acid sandstone and shale materials.	do.....	Slow.....	Light grayish brown.....	do.....	Friable.....	3
Philo stony fine sandy loam.....	Ps.....	do.....	do.....	do.....	do.....	Grayish brown to brownish yellow.	do.....	do.....	3
Pope fine sandy loam.....	Po.....	Soils of well-drained stream bottom lands.	do.....	Moderate.....	do.....	Grayish brown.....	Yellow or brownish yellow.	do.....	2
Roane silt loam.....	Ra.....	do.....	Young stream alluvium washed chiefly from cherty dolomite material.	do.....	do.....	18 to 24 inches of friable brown to yellowish-brown silt loam overlying compact beds of chert.			2
Robertsville clay loam.....	Re.....	Soils of level poorly drained stream terraces.	Old stream alluvium washed chiefly from limestone material.	Level or slightly depressed.	Very slow.....	Light gray.....	Gray mottled with red, yellow, and brown.	Sticky, plastic.....	4
Rolling stony land (Talbot soil material).	RlT.....	Miscellaneous nonarable land types.....	Limestone.....	Rolling to strongly rolling.	Moderate.....	Bedrock outcrops on 25 to 75 percent of the land surface, material similar to Talbot soil in intervening spaces.			4
Rough gullied land: Montevallo soil material.....	RgM.....	do.....	Residuum from weathering of acid fissile shale.	Hilly and steep.....	do.....	Land formerly covered by Montevallo soil that has been reduced to a network of gullies by accelerated erosion.			5
Talbot soil material.....	RgT.....	do.....	Cherty residuum from weathering of limestone.	Steep, some areas rolling and hilly.	do.....	Land formerly covered by Talbot and Fullerton soils that have been reduced to a network of gullies by accelerated erosion.			5
Rough stony land: Muskingum soil material.....	RaM.....	do.....	Sandstone rock.....	Steep and very steep.	Rapid.....	Sandstone bedrock and escarpments cover half or more of land surface, material similar to Muskingum soil in intervening spaces.			5
Talbot soil material.....	RaT.....	do.....	Limestone rock.....	Steep.....	Moderate.....	Bedrock outcrop on 25 to 75 percent of the land surface, material similar to Talbot soil in intervening spaces.			5
Sequatchie fine sandy loam.....	St.....	Soils of gently sloping well-drained stream terraces.	Moderately young stream alluvium washed chiefly from sandstone material.	Nearly level to gently sloping.	do.....	Light brown or yellowish brown.	Yellowish brown, light brown, or reddish brown.	Friable.....	2
Sloping phase.....	Stx.....	Soils of sloping well-drained stream terraces.	do.....	Sloping.....	do.....	do.....	Yellowish brown to brownish yellow.	do.....	2
Sequoia silty clay loam, eroded phase.	Ssr.....	Soils of the undulating and rolling slopes of upland troughs underlain chiefly by limestones.	Residuum from the weathering of interbedded shale and limestone.	Rolling.....	Retarded.....	Grayish brown.....	Brownish yellow.....	Sticky, plastic.....	2
Smooth stony land (Talbot soil material).	SsT.....	Miscellaneous nonarable land types.....	Limestone bedrock.....	Level to gently sloping.	Moderately slow.....	Bedrock outcrop on 25 to 75 percent of the land surface, material similar to Talbot soil in intervening spaces.			4
Stony colluvium (Muskingum soil material).	ScM.....	do.....	Colluvium from sandstone and conglomerate.	Nearly level to strongly rolling.	Rapid.....	Accumulations of sandstone rock fragments in narrow stream valleys and foot slopes.			5
Taft silt loam.....	Tl.....	Soils of level imperfectly drained stream terraces.	Old stream alluvium washed chiefly from limestone.	Nearly level.....	Slow.....	Light gray.....	Grayish yellow to bright yellow.	Friable to compact.....	3
Talbot-Hayter silt loams.....	TH.....	Soils of steep and hilly lower slopes of mountains underlain chiefly by limestones and calcareous shales.	Residuum from weathering of high calcic argillaceous limestone and colluvium from sandstone, calcareous shale, and limestone.	Hilly.....	Moderate.....	Complex of Talbot and Hayter soils; Hayter soils resemble Caylor soils but are younger and have a deeper and more brown surface layer.			4
Steep phases.....	THz.....	do.....	do.....	Steep.....	do.....	do.....			4
Talbot silt loam.....	Ts.....	Soils of the undulating and rolling slopes of upland troughs underlain chiefly by limestone.	Residuum from weathering of high calcic argillaceous limestone.	Undulating.....	Moderately slow.....	Grayish brown.....	Yellowish red.....	Sticky, plastic.....	2
Hilly phase.....	Tsl.....	Soils of hilly and steep slopes of upland troughs underlain chiefly by limestone.	do.....	Hilly.....	do.....	do.....	do.....	do.....	4
Steep phase.....	Tsz.....	do.....	do.....	Steep.....	do.....	do.....	do.....	do.....	4
Talbot silty clay loam, eroded phase.	Ter.....	Soils of the undulating and rolling slopes of upland troughs underlain chiefly by limestone.	do.....	Rolling.....	do.....	do.....	do.....	do.....	3
Tyler silt loam.....	Tm.....	Soils of level imperfectly drained stream terraces.	Old stream alluvium washed chiefly from acid shale and sandstone.	Level or slightly depressed.	Very slow.....	Light yellowish gray.....	Yellowish gray mottled with yellow, brown, and red.	do.....	4
Waynesboro fine sandy loam, eroded phase.	Wfr.....	Soils of sloping well-drained stream terraces.	do.....	Gently sloping to rolling.	Moderate.....	Grayish brown to light brown.	Red or yellowish red.....	Friable.....	2

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