

Soil Survey

Marshall County Kentucky

By

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and**

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and Agricultural Engineering

In cooperation with the
KENTUCKY AGRICULTURAL EXPERIMENT STATION
and the
TENNESSEE VALLEY AUTHORITY

HOW TO USE THE SOIL SURVEY REPORT

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

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and for recreation. The following sections are intended for such users: (1) General Nature of the Area, in which location and extent, physiography, relief, and drainage, climate, water supply, vegetation, organization and population, industries, transportation and markets, and cultural development and improvement are discussed; (2) Agriculture, in which a brief history and the present status of agriculture are described; (3) Physical Land Classification, in which the soils are grouped according to their relative physical suitability for agricultural use; (4) Soil Fertility and Management, in which the present management requirements and productivity of the soils are discussed; and (5) Water Control on the Land, in which problems pertaining to drainage and control of runoff are treated.

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

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

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

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TENNESSEE VALLEY AUTHORITY

SOIL SURVEY OF MARSHALL COUNTY, KENTUCKY¹

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

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¹ This report was revised by R. C. Journey, Division of Soil Survey.

² The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

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AGRICULTURE in Barshall County had its beginning with the coming of the first settlers about 1819 and centered around three main crops—corn, wheat, and tobacco. With its expansion came improved methods of farming, together with a change to a more stabilized system of cropping. A general type of farming is practiced including chiefly corn, tobacco, wheat, strawberries, cotton, lespedeza, cowpeas, and redtop, combined with raising livestock for crop consumption. Soybeans, oats, sweet sorghum, timothy, alfalfa, and potatoes are grown to a less extent, and vegetables are chiefly for home consumption. Industries other than agricultural include operation of a hosiery mill, a cotton gin, flour mills and gristmills, and gathering mussels. To provide a basis for the best uses of the land a soil survey of the county was undertaken, beginning in 1938, by the United States Department of Agriculture in cooperation with the Kentucky Agricultural Experiment Station and the Tennessee Valley Authority.

GENERAL NATURE OF THE AREA

LOCATION AND EXTENT

Marshall County, in the northeastern corner of the Jackson Purchase area, or that part of Kentucky west of the Tennessee River, is bounded by the Tennessee River on the north and east and by approximately straight lines on the south and west (fig. 1). It covers an area of 338 square miles, or 216,320 acres, with maximum length from north to south of approximately 21 miles and maximum width from east to west of about 20 miles. Benton, the county seat, is 20 miles southeast of Paducah and 170, 210, and 225 miles, respectively, southwest of Louisville, Frankfort, and Lexington.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Physiographically, Marshall County is a plain, sloping gently to the north. It is in the part of the northern extension of the East Gulf Coastal Plain section known as the Mississippi embayment area of Kentucky. During this embayment an arm of the ocean extended

from the south over the region into the southern part of Illinois, and it was then or shortly afterwards that the Coastal Plain sand, gravel, and clay underlying practically all the territory now occupied by Marshall County were laid down. These materials overlie a cherty limestone formation that outcrops only as a narrow strip bordering the Tennessee River Valley. Subsequent to deposition the Coastal Plain materials were covered with loess, a wind-blown deposit (4).³ At the present time soils of loessal origin cover most of the smoother uplands of the county.

This plain is modified by a dendritic drainage system into three relief subdivisions: (1) Smoother uplands, (2) rougher uplands, and (3) alluvial valleys (fig. 2).

The smoother uplands, occupying approximately 33 percent of the county, are characterized by nearly level to gently rolling relief (0- to 10-percent slope) and consist largely of interstream divides or remnants of the original plain. The interstream divides are wider and

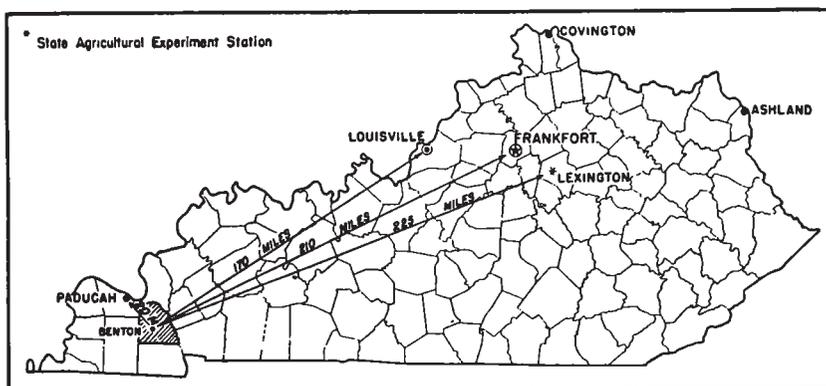


FIGURE 1.—Location of Marshall County in Kentucky.

more extensive between the East Fork and West Fork Clarks Rivers from the southern county line to the vicinity of Van Zora School and between the East Fork Clarks and Tennessee Rivers from the vicinity of Salem Chapel School to Palma and northwest of Sharpe. These more extensive parts represent a youthful stage of relief wherein dissection has progressed slightly and differences in altitude are from 20 to 40 feet. The rest of the smoother uplands represents a more advanced stage of relief of somewhat greater dissection. Drainage channels penetrate the smoother uplands sufficiently to afford good surface drainage except in a few very small areas, principally in the area locally known as the "Flatwoods" southwest of Benton in the vicinity of Enterprise School.

The rougher uplands, covering approximately 27 percent of the county, consist of the strongly rolling and hilly land along the East Fork and West Fork Clarks Rivers and their tributaries and the Tennessee River and creeks flowing into it. The relief is in a more advanced stage and is characterized by thorough dissection of the

³ Italic numbers in parentheses refer to Literature Cited, p. 109.

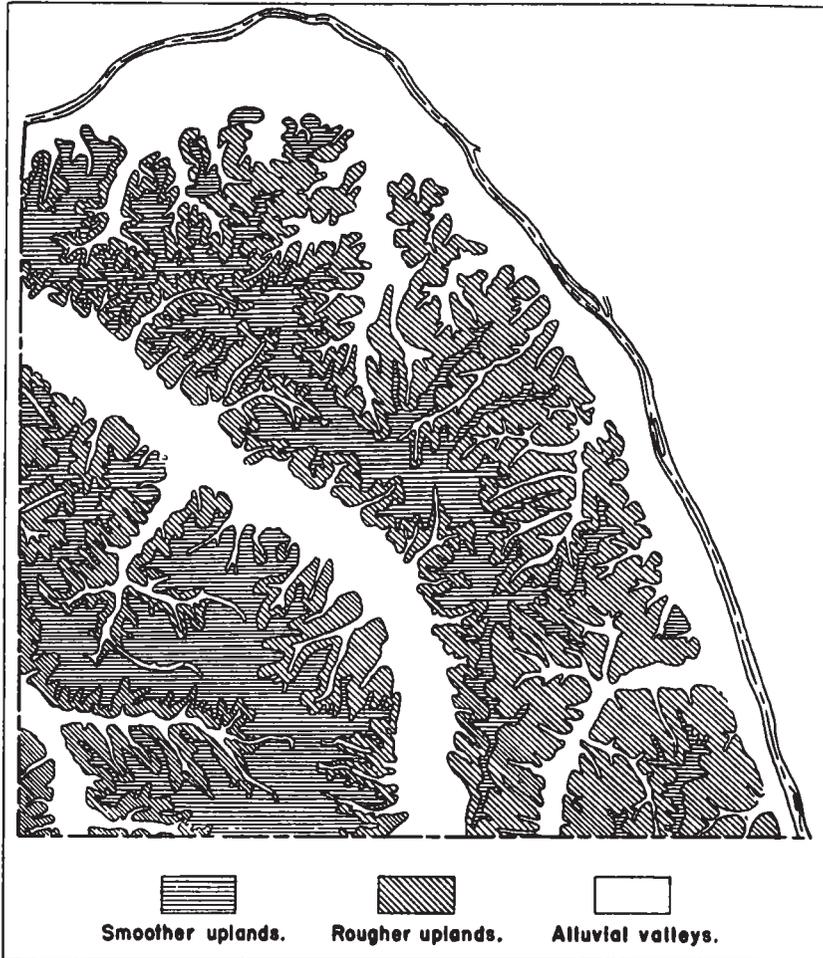


FIGURE 2.—Relief areas of Marshall County, Ky.

original plain. Drainageways ramify all parts, and what remains of the original plain consists of long narrow divides or ridges having many short spurs on each side. These divides are gently sloping but in most places break sharply into steep slopes extending to the bottom lands. Streams have cut valleys 75 to 150 feet below the general level of the interstream ridges.

The alluvial valleys, comprising about 40 percent of the county, include the bottom lands and terraces of the Tennessee River and the smaller rivers and creeks. The valley floors of the smaller rivers and larger creeks are comparatively wide, those of the East Fork and West Fork Clarks Rivers and Jonathan, Cypress, and Middle Fork Creeks being $\frac{3}{4}$ to $1\frac{1}{2}$ miles wide. These streams in their middle to lower courses have nearly reached grade and are rather sluggish, meandering over wide, flat, and, in places, poorly drained flood plains.

The smaller creeks and branches have relatively strong gradients, especially in the rougher uplands, and many of them flow in the U-shaped valleys, where inundation occurs only in extremely high floods. Many of these streams have carved deep, narrow channels in unconsolidated sand, gravel, and clay of the Coastal Plain, and large quantities of such material have been deposited in gently sloping alluvial fans where the streams enter larger stream valleys of lesser gradient. The streams flowing through the rough eastern part of the county, where the underlying material is highly weathered cherty limestone, have carved shallow channels in most places. They flow in wide, chert-covered beds and no longer are deepening their channels. Nearly flat to gently sloping discontinuous terraces, generally separated from the bottom lands by short gentle slopes or by escarpments 10 to 20 feet high, are in most of the larger creek and small river valleys.

The alluvial plain that comprises the bottoms and terraces of the Tennessee River ranges from $\frac{1}{2}$ to 2 miles wide, the width of the bottoms being a few rods to about half a mile. The bottoms are somewhat undulating and consist of natural levees near the river and of low ridges and intervening sloughs or swales back from the river but nearly parallel to it. A few of the sloughs are very low, apparently once stream channels but now covered with standing water most of the year. The terraces, or second bottoms, are old first bottoms now above the usual overflow, because the river has changed its course and cut its channel deeper, thereby forming the present lower lying flood plain. These terraces, generally separated from the first bottoms by more or less steep slopes or abrupt escarpments 10 to 20 feet high, consist of roughly parallel low ridges and swales, most of the latter being poorly drained.

The general elevation of the smoother uplands is 450 to probably 525 feet above sea level. The highest and lowest measured elevations are 511 feet at Aurora School and 314 feet on the bank of the Tennessee River about one-sixth mile upstream from Altona, making a range in elevation of 197 feet. The altitude of that part of the smoother upland area between Brewers, Hardin, Benton, and Oak Level, however, is probably slightly higher than that at Aurora School, but there are no measured elevations in this area. Other altitudes are as follows: At the railroad stations in Hardin and Benton, 419 and 373 feet, respectively; at a point along the railroad one-seventh mile northwest of the railroad station in Elva, 345 feet; crossroads half a mile east of Palma, 464 feet; Tatumsville, 473 feet; crossroads at Briensburg, 494 feet; junction of roads at Maple Spring Church, 494 feet; one-fourth mile northwest of Unity School, 480 feet; south of Eggner Bridge, 337 feet; Birmingham, 350 feet; bank of the Tennessee River near Illinois Central Railroad bridge, 332 feet; 100 feet west of road intersection at Altona, 348 feet; and Ohio River Pool 52, 302 feet.⁴

The county lies wholly in the drainage basin of the Tennessee River and is drained through the East Fork Clarks and West Fork Clarks

⁴ Elevation from the Tennessee Valley Authority and from their planimetric maps, advance sheets.

Rivers and other smaller streams. These rivers and Jonathan, Rockhouse, Wades, Duncan, and Soldier Creeks are permanent streams. Practically all the other creeks are intermittent, being dry during much of the year, although holes in some do not dry up in summer. A few creeks, especially Middle Fork, Little Cypress, Cypress, Bear, and Ledbetter, are permanent in their lower courses and are fed largely by springs emerging at or near the base of hills that generally contain sandy strata over clay or cherty limestone. Most of these springs are in the southwestern part of the county, but a few are along the East Fork Clarks River and Jonathan and Ledbetter Creeks. Nearby residents use them to supply water for their homes and livestock. Clear Pond, northwest of Gilbertsville, is the only natural permanent lake in the county, probably filling a remnant of an old river channel. Several natural intermittent ponds or lakes, mostly in sloughs, are in first bottoms and terraces of the Tennessee River.

CLIMATE

The climate of Marshall County is temperate and humid. Winters and summers are usually moderate, having a range of about 38° F. between mean winter and summer temperatures. Temperatures have been as high as 110° and as low as -20°, but such extremes are infrequent and of short duration. Winters are rather short and often mild and are characterized by brief cold spells and frequent sharp changes in temperature accompanied by high humidity. Temperatures of -6° or lower were observed six times during the 20-year period 1895-1914 (12). The average annual number of days with temperatures continuously below freezing during the day is approximately 13, and the average annual number of days with only the minimum temperature below freezing is about 65. Outdoor work may be performed during practically all winters, and during milder ones hardy vegetables, as turnips and mustard, are successfully grown.

Frequent freezing and thawing cause considerable heaving of the land and winterkilling of grain, clover, and other winter crops, especially on the more poorly drained soils. The average annual snowfall is about 12 inches of unmelted snow, and the average annual number of days with snowfall is approximately 12, with snow covering the ground about 11 days. During this brief period only meager protection is afforded grains and other winter crops (11).

The records of the United States Weather Bureau station at Mayfield (Graves County) show that the average frost-free season is 197 days—from April 8 to October 22—which affords sufficient time for crops to mature except possibly cotton. Killing frosts have occurred as late as April 22 and as early as October 7, but such extremes are rare. Tree fruits, strawberries, and raspberries are sometimes injured by late frosts, injury probably being more frequent in the valleys of the more hilly parts of the county. Late-maturing cotton and corn grown on bottom land are sometimes injured by frost early in fall. The grazing period extends from early in April to the middle of November.

The mean annual precipitation for Marshall County is probably about the same as that recorded at Mayfield—46.32 inches. The

annual precipitation was less than 85 percent of the average in only about 3 years of the 20-year period 1895-1914 (11). Although the heaviest rainfall is in winter and early in spring, it is fairly evenly distributed throughout the year. Short droughts often occur in summer and early in fall, but severe ones are infrequent. In the 20-year period 1895-1914 there were about 14 periods of 30 consecutive days or more in which less than 0.25 inch of rain fell in 24 hours during the period March 1 to September 30. Rainfall comes largely in moderate to light rains and is usually sufficient for all the crops of the area. The average annual number of days with more than 2 inches is 2 to 3, and a like number of days can be expected each year in which the precipitation is more than 1 inch in an hour. During these downpours much water is lost by surface runoff, and if they occur when the land is largely bare and not frozen, serious damage results. During droughts crops return reduced yields but seldom fail. Excessively wet springs often delay planting, and wet seasons sometimes produce partial or complete crop failures on the poorly drained soils.

About 1 or 2 days with hail can be expected each year during the frost-free season. Although many hailstorms are light and local in character, considerable damage may be done to tobacco or corn crops on one farm, while such crops on the adjoining farms may escape harm. Occasional sleet or ice storms in winter may damage fruit trees and ornamental shrubs considerably. Thunderstorms are frequent, particularly in summer, occurring on an average of 60 days a year. Dense fogs may be expected about 10 days a year.

The prevailing winds are southerly or southwesterly, but in winter much of the wind is northerly or northwesterly. Wind velocities are moderately low, and destructive windstorms are infrequent.

The normal monthly, seasonal, and annual temperature and precipitation and the monthly, seasonal, and annual precipitation for the driest and wettest years, compiled from records of the United States Weather Bureau station at Mayfield (Graves County), are given in table 1. These data are fairly representative of climatic conditions in Marshall County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Mayfield, Graves County, Ky.*

[ELEVATION, 364 FEET]

Month	Mean temperature	Precipitation		
		Mean	Total for the driest year	Total for the wettest year
	°F.	Inches	Inches	Inches
December.....	40. 4	4. 32	2. 23	8. 75
January.....	37. 3	5. 16	2. 29	8. 60
February.....	40. 0	3. 38	. 67	3. 73
Winter.....	39. 2	12. 86	5. 19	21. 08
March.....	49. 7	4. 03	1. 14	5. 32
April.....	58. 3	4. 26	2. 06	5. 27
May.....	66. 5	4. 00	1. 83	6. 57
Spring.....	58. 2	12. 29	5. 03	17. 16
June.....	75. 0	3. 80	1. 43	3. 43
July.....	78. 9	3. 54	6. 55	2. 88
August.....	77. 5	3. 71	3. 71	6. 66
Summer.....	77. 1	11. 05	11. 69	12. 97
September.....	72. 2	2. 98	. 48	4. 38
October.....	60. 5	3. 26	7. 18	2. 44
November.....	49. 1	3. 88	2. 47	4. 41
Fall.....	60. 6	10. 12	10. 13	11. 23
Year.....	58. 8	46. 32	¹ 32. 04	² 62. 44

¹ In 1941.² In 1923.

WATER SUPPLY

Probably half the homes on the smoother uplands and on ridges of the rougher uplands have open dug wells, the rest depending on water collected in cisterns. In these areas a satisfactory supply of water generally is available at a depth of 35 to 50 feet, though in some localities it is necessary to dig wells to a depth of 100 feet or more. In many places on the ridges in the eastern hilly area above the Tennessee River, a supply of water cannot be obtained even at the greater depths. Very few pumps are used, either for wells or cisterns. To supply water for livestock most farms depend largely on small artificial ponds or reservoirs of surface rain water, but these generally fail during droughts, and water has to be hauled from wells. In the valleys a constant water supply generally can be obtained at a depth of 10 to 30 feet.

VEGETATION

According to information obtained from older inhabitants and available descriptions of the earlier conditions of the county, some of the more level interstream areas west and northwest of Hardin and

in the flatwoods area southwest of Benton were largely prairies covered with tall grass when white men first came (4). These untimbered areas were formerly called "barrens," as they were considered infertile. The rest of the county had a forest cover of hardwoods. The treeless condition of the barrens apparently was due to fires started by the Indians (3). Beginning about 1863, after the removal of the Indians and the increase in white settlers, fires decreased. At that time the forests extended in area, so that much of the original prairies had to be cleared of timber before they could be plowed.

The first trees to gain a foothold on the barrens were probably blackjack oak, followed by red oak and a few post oaks (2). At present the forest cover on the former prairies consists mainly of post, southern red, and black oaks, and hickory, with some red, blackjack, white, and swamp white oaks, persimmon, sassafras, and dogwood. Post and Southern red oaks are dominant in the more poorly drained areas and white and black oaks and hickory on the better drained areas. A similar type of forest is common on the smoother uplands that were originally in timber. On the narrow ridge tops in the rougher uplands are a few black tupelo (blackgum), shingle oak, scarlet oak, and sourwood trees.

In the rougher uplands the forest cover consists chiefly of black, white, red, post, and blackjack oaks, and hickory, with some dogwood, tuliptree, winged elm, and shingle, scarlet, and chestnut oaks. Locally, beech, chestnut, and sugar maple trees are numerous. Persimmon, sassafras, wild plum, and winged elm, together with briers, sedge, vines, and sumac, are very numerous in cleared fields that have remained idle for a few years.

The bottom lands and stream terraces originally were heavily forested with a much greater variety of trees than were the uplands, and from all available information the present forest consists of practically the same species.

In the better drained areas the predominant trees are swamp chestnut, white, red, black, post, and southern red oaks, silver, sugar, and red maples, hickory, sweetgum, black tupelo, hackberry, sycamore, tuliptree, and white poplar, with some pin, overcup, and Shumard red oaks, winged elm, beech, river birch, honeylocust, winterberry, hackberry, pecan, red haw, black cherry, and walnut.

In the poorly drained areas the predominant species are Southern red, swamp chestnut, pin, post, and willow oaks, sweetgum, hickory, silver and red maples, and hackberry, with some black, shingle, red, overcup, and swamp white oaks, green ash, white and winged elms, white poplar, black tupelo, sycamore, persimmon, river birch, and willow. The trees in the very wet or swampy areas are predominantly cypress, water tupelo, willow, buttonbush, and willow, pin, and overcup oaks.

ORGANIZATION AND POPULATION

Marshall County is one of the eight counties that represent the territory originally included in the Jackson Purchase, which was acquired from the Chickasaw Indians in 1818 (1). Andrew Jackson led in the negotiations with the Indians, and his name is commonly associated with the area. In 1821 this territory was organized as Hickman County with the county seat at Columbus. Calloway County was formed from the east side of Hickman in 1822, and the county seat was

located at Wadesboro (2). In 1842 Marshall County was formed from the northern part of Calloway and was named in honor of Chief Justice John Marshall. A site for the county seat was chosen near the center of the county and was named for Thomas H. Benton, United States Senator from Missouri (5). Benton was incorporated in 1845.

The first permanent settlement in what is now Marshall County was made in the spring of 1819 on Wades Creek southwest of Hardin, though corn is reported to have been raised near the mouth of Jonathan Creek in 1818 (5). In 1819 and in the next few years many settlements were made near the creeks in the southern part of the county. The first settlements were made in this locality probably because of the presence of several springs and a suitable supply of water. The first settlement in the northern part was made at Altona on the Tennessee River about 1820. In 1822 a Government land office was established in Wadesboro. In 1827 the price of land was reduced from \$1 to 50 cents an acre, and a great increase in immigration followed. A settlement in Briensburg was made about 1820, and the population grew to about 250 by 1900 but has since greatly declined. Birmingham was settled in 1849 and was incorporated in 1860, Gilbertsville was settled about 1870, and Calvert City was incorporated in 1871. The town of Hardin was laid out in 1891 along the railroad, and by 1894 its population had increased to 294 (5).

The early settlers came largely from counties farther east in Kentucky and from Virginia, eastern Tennessee, and the Carolinas. Almost all were of American parentage.

The population of the county increased gradually from 9,647 in 1880 (United States census) to 15,771 in 1910. A slight decrease in the next decade and a 15 percent decrease in the decade 1920-30 was principally due to movement of the people to industrial centers, mainly Detroit. The 1940 census showed an increase of 28.8 percent, or a total of 16,602, all classed as rural, the average density being 49.4 a square mile. Ninety-nine percent is native white, 0.1 percent foreign-born white, and 0.9 percent Negro. The population is fairly evenly distributed over the county, except in the first bottoms of the larger streams, where it is sparse. A number of local stores and trucks peddling groceries and other necessities serve the people.

Benton, the county seat and largest town, has a population of 1,906. Smaller places are Hardin (414 population), Calvert City, Birmingham, Sharpe, Palma, Briensburg, Brewers, Olive, and Oak Level. As these towns depend almost wholly on the agriculture in the vicinity, the most prosperous towns are associated with the more level and more prosperous farming areas.

INDUSTRIES

Although the county is almost wholly agricultural, a hosiery mill and a small cotton gin in Benton furnish employment for a number of men and women. Small flour mills are in Sharpe and Hardin, and gristmills are located at different places in the county. During summer a few men gather mussels in the Tennessee River.

TRANSPORTATION AND MARKETS

The transportation system is adequate in parts of the county. Two railroads—the Nashville, Chattanooga and St. Louis Railway

and the Illinois Central Railroad—cross the county. The former follows the East Fork Clarks River Valley from Hardin near the southern county line through Glade, Benton, and Iola to Elva near the western line; the latter crosses the northern end of the county, passing through Little Cypress, Calvert City, and Gilbertsville.

Paved State highways extend from the county line south of Hardin through Benton and Palma to the county line west of Sharpe and from both Benton and Hardin to the county line west of Brewers; good graveled State highways also extend from near Palma through Calvert City to Gilbertsville, from north of Benton through Briensburg to Birmingham, from Benton to Eggner Bridge, and from Hardin to Eggner Bridge; and bus and trucking services are available to most of the surrounding cities. In the smoother uplands, local public roads are numerous and in many places follow section lines or parts of such lines; in the rougher uplands and bottom lands, they are not numerous, generally are crooked, and follow ridges or valleys. Fords over small creeks are common. About 60 percent of the public roads are graveled to some extent and can be traveled throughout most years. Most of the graded dirt roads, especially in the hilly areas, are impassable to automobiles and trucks during much of the winter and early in spring and during other wet seasons. Neither the graveled nor the graded dirt roads are well maintained.

Benton, which is centrally located, is the largest town and the chief trading and shipping point. Hardin is the important market and shipping point in the southern part of the county, and Calvert City, Gilbertsville, and Little Cypress are the smaller towns and local shipping points on a railroad in the northern part.

The Tennessee River is navigable, and the eastern and northern sides of the county are served by river transportation.

CULTURAL DEVELOPMENT AND IMPROVEMENT

Eight 4-year high schools are conveniently located in the county. The schools of the rural districts are largely of the one-room type. Churches and mail routes serve all communities. Most localities have few telephones, and only a few farms are equipped with electric lights or power. In general, the condition of the buildings, the farm improvements, and the degree to which modern farm conveniences are employed are closely associated with the character of soil and other land conditions.

On the smoother uplands the prevailing farm buildings consist of a bungalow or one-and-a-half story frame house, garage, small chicken house, small barn for the work animals and dairy cows, small corncrib, and one or two tall tobacco barns, some of which are new type with ventilators. With the exception of the house most of these buildings are unpainted. The farms are fairly well fenced with woven or barbed wire. Nearly every farm has an automobile and a radio.

On the rougher uplands the prevailing farm buildings consist of a small frame or log house, a shed or small livestock barn, and a tall log or frame tobacco barn of the old type without ventilators. Generally the buildings are unpainted, and farms are poorly fenced. Buggies and wagons are often used as means of transportation, and telephones and radios are not common.

Generally the farm buildings on the Tennessee River terraces are much the same as those on the smoother uplands, except that the live-stock barns are somewhat larger and the tobacco barns are fewer.

AGRICULTURE

Previous to the coming of white men the area that is now Marshall County was visited by hunting and warring expeditions of Indians but apparently was not inhabited or farmed by them (3). The agriculture of the early white settlers was mainly the subsistence type. Corn, for the first few years the chief crop, was well adapted to the newly cleared land, yielded well, was comparatively easy to grow and harvest, and served both as human food and as grain and forage for livestock. A small space was used for a garden, and a small patch of turnips was usually grown.

After cropping the newly cleared land for a few years to corn, wheat was grown, largely for consumption in the home, and any surplus was shipped by boat to New Orleans. Since most of the early settlers migrated from tobacco-growing regions, tobacco soon became an important crop and has continued to be the most important cash crop. The tobacco grown was air-cured, and most of it was exported to European countries by way of the Mississippi River and New Orleans. Hogs were important in the domestic economy, as "hog and hominy" constituted the principal diet. A cow or two were kept for milk, and enough sheep were raised to supply wool for home-made clothes. Horses were the chief work animals and means of transportation (5).

Marshall County has been almost wholly agricultural throughout its history. Gradually the agriculture became somewhat more diversified. Oats, rye, cotton, sweetpotatoes, and sweet sorghum were introduced but were of minor importance. Hay and forage crops, especially redtop and red clover, increased in importance as the raising of livestock became more general. Mules became important as work animals, and poultry raising increased.

CROPS

In 1879 the principal crops grown in the county were corn, wheat, oats, and tobacco, and less important ones were sweetpotatoes, potatoes, sorghum cane, rye, cotton, dry peas and beans, and hay and forage crops. Between 1879 and 1939 the most significant changes were a large increase in the production of hay and forage crops; a large increase in the production of tobacco, followed by a sharp drop (7); a decrease in the production of small grains; and an increase in the production of two cash crops, strawberries and cotton. At present the most important crops are corn, tobacco, strawberries, cotton, wheat, lespedeza, cowpeas, and redtop; less important are soybeans, oats, sweet sorghum, and timothy. Red clover, alfalfa, potatoes, sweetpotatoes, dry edible beans, and raspberries are grown to some extent.

Corn has always occupied a larger acreage than any other crop grown, although its acreage has fluctuated somewhat, reaching a peak in 1909. It yields better than other grains, furnishes a large quantity of forage, and requires inexpensive machinery for cultivation. Its easy storage and use directly on the farm are advantages in areas where roads are poor and markets distant. The soils, however, except

some on first bottoms and the Tennessee River terraces, because of their low organic-matter content and relatively low fertility in their natural condition, are not very productive for this crop.

Corn is grown on practically every farm, and in 1939 the average yield for grain was 19.3 bushels an acre (1940 census). The percentage of farm land used for this crop is much higher in the first bottoms than in any other part of the county. This correlates with the higher natural fertility and better moisture relations of the soils, enrichment by overflow, and the favorable lay of the land for all tillage operations. The least percentage of land in corn is in the rougher uplands because of the unfavorable lay of land and the erosion hazards.

Corn generally follows meadow or pasture and is rarely grown on the same land more than 2 years in succession, except on some of the first bottoms, where in many places it is grown continuously. About 15 percent of the corn is fertilized, principally with 20-percent superphosphate, at the rate of 100 pounds an acre. Part of the corn, especially on the uplands, is cut and the fodder, or stover, used for winter feed; some is "topped" or cut above the ears. Silos are few, and very little corn is hogged-off. A small surplus, which comes from the bottom lands of the Tennessee River and other rivers, is shipped out of the county in favorable years.

Tobacco has been supplanted to some extent by strawberries and cotton but still ranks with strawberries as one of the most important cash crops (?). Its importance is due to several factors—suitability of a considerable area of soils to growing a good grade of dark open-fire-cured tobacco, long experience of many farmers in handling and producing it, large yields obtained from a small acreage, plentiful labor supply, and to small bulk and unperishability, which are distinct advantages where roads are poor and markets distant. Tobacco is grown to some extent in most parts of the county, but it occupies a larger acreage and furnishes a larger proportion of the income on the smoother uplands, especially south, southwest, and west of Benton and in the vicinity of Briensburg and Palma, where most of the soils have a compact subsoil, are less severely eroded, and produce a crop of good grade. In the rougher uplands, where erosion and moisture conditions are unfavorable, a lower grade of tobacco is generally produced. Soils on the first bottoms and the Tennessee River terraces produce a fairly high yield, but it is usually coarse, rough, and of lower grade. The Federal census indicates that the acreage and production in the county reached the peak in 1919, when the average yield was 807 pounds an acre. In 1939 the average yield was 786 pounds.

Type 23 of fire-cured tobacco, also called western fire-cured, is mainly grown. This dark heavy-bodied form has broad dark-green heavily drooping leaves, which are gummy to the touch. Its principal domestic use is in the manufacture of snuff, though some is used in the manufacture of cigars and for plug and smoking tobacco. A large part of it is exported (6). Some burley is now grown.

Tobacco beds are usually prepared in February or early in March in a new clearing in the woods and are usually sterilized by burning poles and brush on them, after which manure and nitrate of soda are applied. Plants are transplanted by hand to the fields from May 1 to June 10. The best land available, especially land that has been in a hay crop or pasture, generally is selected. A complete fertilizer is

nearly always applied, either broadcast or in the hills or rows, at the rate of 100 to 250 pounds an acre by most farmers, though superphosphate alone is used by some. Manure is applied when available.

The tobacco plants are topped in August, when they have 10 to 16 leaves, after which they are suckered 2 or 3 times. When thoroughly ripe, usually in September, the stalks are split nearly to the ground, cut off, and hung on laths suspended in the curing barn. Although most of the barns are of the old frame or log type, the newer ones are equipped with ventilators so as to control better the humidity and temperature during the curing process. After the tobacco has yellowed in the barn for 3 or 4 days, slow-smoking open fires are started to hasten curing. After the thoroughly cured tobacco has become pliable by the absorption of moisture during a damp period, the leaves are stripped off, sorted into grades, and tied into hands of about six leaves each (22). Most of the tobacco is marketed by auction on the loose-leaf floors at Murray, Mayfield, and Paducah, although some is sold direct to buyers at the barn.

Although strawberries are grown throughout most of the county in relatively small acreages, they are produced somewhat more extensively in the northwestern part near Paducah, which is the center for the strawberry shipping association. They are best suited to some of the soils of the first bottoms of small streams that do not overflow and of the Tennessee River terraces, but they are grown on many different kinds of soils with fairly good results.

In growing strawberries, it is preferable that they do not follow a sod because of the danger from white grubs. About 50 percent of the land is fertilized, mainly with about 100 pounds of 20-percent superphosphate, and stable manure is applied whenever available. The plants are set early in spring, cultivated at frequent intervals until late in summer, and generally mulched with straw in winter. The berries are picked late in May or early in June, principally by contract labor by women and children. Most of them are shipped by motortruck to Benton, Calvert City, and Paducah, from which points they go in carload lots to northern markets by growers' shipping associations. The plants are usually allowed to bear for 2 years. Yields vary greatly, the average acre yield being about fifty 24-quart crates in 1929 and 1939 (United States census). The more successful growers produce 100 to 150 crates an acre, and yields of more than 200 crates are not uncommon. The Aroma is considered the standard variety grown for shipping, though the Blakemore variety also is grown.

Red raspberries and dewberries are grown on several farms and marketed in the same way as strawberries.

Cotton has become a minor cash crop within the last 20 to 30 years, and practically all of it is sold to the gin in Benton as seed cotton. It is grown principally in the southeastern and eastern parts of the county, where a large proportion of the arable land is not well suited to tobacco and where many farms are at considerable distances from strawberry shipping points. Most of it is grown on the lighter textured soils of the Tennessee River terraces, the well-drained soils of the smoother uplands, and the better drained soils of seldom flooded bottoms. These soils are naturally warmer than the others and cause earlier germination, growth, and maturity, which are essential to successful production in this climate. Approximately 50 percent

of the cotton is fertilized, mainly with about 100 pounds an acre of 20-percent superphosphate. The Federal census shows an average yield of about 216 pounds of lint cotton an acre in 1929 and 212 pounds in 1939.

Wheat, the principal small grain, is grown on a larger proportion of arable land on the Tennessee River terraces and the smoother uplands than elsewhere. It is grown to some extent on the bottoms, but there it is more subject to weed pests, lodging, and flood damage, and the quality is poorer. This crop generally follows tobacco, corn, cowpeas, or soybeans. Approximately 75 percent of the wheatland is fertilized, mainly with 100 pounds an acre of 20-percent superphosphate. The Federal census shows an average yield of 10.4 bushels an acre in 1929 and 10.3 in 1939. Most of the wheat is either sold to the flour mills in Sharpe and Hardin or ground for home use on the farms. Some is fed to livestock on the farms, and a small quantity is shipped out of the county. According to statements of local flour-mill operators, the county does not produce enough wheat to supply its own needs.

Lespedeza constitutes practically the only legume for pasture and, unless the season is too droughty, furnishes fairly good summer and early fall pasture. The proportion of land planted to it is considerably higher in the smoother uplands than in other parts of the county. It grows fairly well on acid soils, though liming improves its growth. Korean is the most important variety, but some Kobe and a very small acreage of sericea lespedeza are grown. Common lespedeza comes up voluntarily throughout most of the county and furnishes considerable pasture. Korean and Kobe are more commonly used for hay because of their larger growth. A few farms produce Korean seed.

Cowpeas and soybeans are other important leguminous hay crops, practically all harvested for hay. They grow fairly well on acid land, and the larger proportion is produced on first bottoms and in the parts of the county where dairy cows are more numerous. They are generally drilled and not cultivated. On a few farms red clover has been successfully grown during the last few years on soils that have been limed. Alfalfa and sweetclover are planted on a small acreage of limed soils with varying degrees of success. Crimson clover sometimes is grown as a winter cover and pasture crop.

Redtop is by far the most important hay and pasture grass, although the yields of hay are low. It grows well on acid soils, is fairly well adapted to poorly drained soils, will withstand considerable drought, and may be seeded at small cost. For pasture use it is ordinarily mixed with lespedeza. Timothy, either alone or mixed with redtop or lespedeza, is grown on a small total acreage. It is less well suited than redtop to the thin soils of the uplands but makes a better hay crop on the well-drained soils of the bottoms. Practically no bluegrass or other grasses are grown.

About an acre or less of sorghum cane is grown on many farms. Probably half the total acreage is used for sirup and the rest for forage. According to statements of growers, the gray soils of the upland and stream terraces produce the best quality of cane for sirup. An acre of cane produces 50 to 60 gallons of sirup, most of which is used in the farm homes, but a surplus from many farms is sold to local markets.

Other field crops grown and their acreages in 1939 (1940 census) are as follows: Barley, 23; rye, 18; broomcorn, 2; popcorn, 2; and peanuts, 8 acres.

With the exception of strawberries in recent years, fruits and vegetables have never been important commercially. Most farms, however, have a small orchard, vegetable garden, and small truck patch to furnish fruits and vegetables for home consumption. Any surplus is sold locally. From 1889 to 1939 the number of apple trees of bearing age decreased from 31,493 to 16,872 and plum trees from 4,659 to 1,360; peach trees increased from 13,808 to 15,506, pear trees from 561 to 1,291, and cherry trees from 634 to 1,378. From 1899 to 1939 the number of grapevines increased from 781 to 1,544; and in 1939 there were 4 acres in blackberries and dewberries and 55 in raspberries. Melons, especially watermelons, are grown commercially on a few farms but are mostly sold locally. A few acres of tomatoes are grown in the vicinity of Gilbertsville and Calvert City for the packing plant in Paducah. Surpluses of potatoes, sweet-potatoes, beans, peas, sweet corn, turnip greens and roots, radishes, cabbage, tomatoes, and blackberries are sold by a few farms to the local markets. Wild plums and blackberries grow on abandoned and idle land and serve as a source of fruit.

The acreages of the principal crops in Marshall County from 1879 to 1939, as reported by the United States census, are given in table 2.

TABLE 2.—*Acreages of the principal crops in Marshall County, Ky., in stated years*

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, harvested for grain.....	28, 379	28, 612	32, 368	39, 807	30, 407	27, 112	29, 782
Wheat.....	9, 766	5, 498	8, 483	3, 388	7, 790	1, 422	2, 011
Oats:							
Threshed.....	3, 410	5, 132	1, 269	696	648	269	20
Cut and fed unthreshed.....						770	46
Potatoes.....		256	103	170	164	260	231
Sweetpotatoes and yams.....	368	162	90	94	139	219	161
Cowpeas and other dry peas.....			92	11	26 ¹	1, 165 ¹	1, 269
Dry beans (mostly soybeans).....			8		20	1, 590 ¹	1, 460
All hay.....	711	4, 624	5, 727	9, 831	12, 441	12, 758	14, 627
Clover or timothy, alone or mixed.....				4, 278	2, 904	2, 187	993
Clover alone.....			1, 017		414	1, 884	² 81
Lespedeza.....							5, 980
Alfalfa.....					14	305	140
Small grain hay.....			777	1, 344	1, 743	190	42
Annual legumes for hay.....					438	1, 712	2, 536
Other tame hay.....			3, 842	4, 105	6, 638	5, 725	4, 083
Wild hay.....			91	104	290	755	772
Silage and forage.....			40	90	1, 392	³ 915	³ 297
Sorghums, cut for silage, hay, or fodder.....						219	252
Tobacco.....	2, 085	2, 870	4, 949	7, 123	14, 405	5, 339	2, 026
Cotton.....	23	4	1			162	366
Sweet sorghums for sirup.....		816	176	630	690	356	207
Strawberries.....			(⁴)	4	4	696	1, 822

¹ Partly duplicated in annual legumes for hay.

² Sweetclover.

³ Corn

⁴ Less than 1 acre.

FERTILIZER PRACTICES

Fertilizer was used on 928 farms, or 42.5 percent of all farms in 1939 (1940 census), compared with 1,729 farms, or 51.6 percent of the total, in 1919. The greatest increase in the quantity used was during the decade 1909-19, which coincided with the greatly increased tobacco acreage in that period.

The most commonly used fertilizer is 20-percent superphosphate, which is used chiefly for wheat, strawberries, cotton, and corn. A large proportion of the total quantity of fertilizer is applied to tobacco land. Mixtures of 4-8-4 and 3-8-6 (percentages, respectively, of nitrogen, phosphoric acid, and potash) complete fertilizer are used. Nitrate of soda is sometimes a top dressing for tobacco and commonly is a fertilizer for the tobacco plant beds. Practically none of the fertilizer is home-mixed. Barnyard manure is applied to the land when available. The use of ground limestone has greatly increased since about 1935; previously very little had been used.

LIVESTOCK AND LIVESTOCK PRODUCTS

The most important classes of livestock on farms in this county are horses, mules, dairy cattle, hogs, and chickens.

On April 1, 1940, there were 4,496 work animals, an average of about 2 a farm, mules representing about 51 percent and horses 49 percent. The number has decreased considerably in the last two decades, owing in part to a decrease in the number of farms and an increase in the number of tractors. Most of the animals are medium to small, and, especially in the hilly areas, many of them are inferior in quality—practically no purebred horses are in the county. A considerable number of young mules are being raised, although not enough to supply the demand. Many mules are sold or traded each month in Benton.

The number of cattle of all ages increased about 10 percent from 1920 to 1930; the numbers over 3 months old on April 1 in 1930 and 1940, respectively, were practically the same. In 1940 the average number was approximately three head a farm, two of these being cows and heifers 2 years old or older, of which approximately 94 percent were kept mainly for milk. Practically all the dairy cows are Jerseys, but only a few are purebred. Dairying is not specialized, and few farms have more than three or four milk cows, but some farmers near Benton and other larger towns keep larger herds and sell whole milk in the towns. Milk is collected from several farms in the southern and southwestern parts of the county by trucks from milk-processing plants in Murray (Calloway County) and Mayfield (Graves County). Milk not needed for consumption in the farm homes is sold largely to local cream stations or is shipped to Paducah and Fulton, Ky., Evansville, Ind., or Chicago, Ill.

Relatively few farms raise beef cattle, and most of these are on the Tennessee River bottoms and terraces where a surplus of corn is produced and pastures are better. A few have purebred Hereford and Aberdeen Angus.

The number of hogs of all ages decreased about 45 percent from 1920 to 1930, but increased in the next decade, until on April 1, 1940, there were 7,529 over 4 months old. The majority of farms do not raise enough hogs for their home supply of meat. Several farms in the Tennessee River bottoms and terraces feed a number of hogs and derive much of their income from the sale of the fattened hogs to local buyers, who ship them, along with veal calves and a few beef cattle, to East St. Louis. The Duroc and Poland China breeds predominate, though practically none is purebred.

Chickens constitute an important source of farm income, although practically none of the farms specializes in raising chickens. On April 1, 1940, there were 79,887 chickens over 4 months old on farms, or an average of 37 a farm. Almost every farm has a small flock, and any surplus of eggs and chickens is sold to the local markets or to hucksters. Other poultry, sheep, goats, and bees are of minor importance, none of the farms raising enough to furnish an important part of the income.

The number of domestic animals on farms and the value of certain classes of agricultural products, as reported by the United States census, are given in tables 3 and 4.

TABLE 3.—*Number of domestic animals on farms in Marshall County, Ky., in stated years*

Livestock	1920 ¹	1930 ²	1940 ³	Livestock	1920 ¹	1930 ²	1940 ³
Horses.....	3, 790	1, 923	2, 203	Sheep.....	1, 550	1, 601	474
Mules.....	3, 765	3, 012	2, 293	Goats.....	539	408	364
Cattle.....	7, 395	8, 142	6, 830	Chickens.....	103, 778	79, 310	79, 887
Hogs.....	11, 355	6, 261	7, 529	Bees (hives)---	1, 314	857	210

¹ Animals of all ages on Jan. 1, 1920.

² Animals of all ages on Apr. 1, 1930, excluding chickens under 3 months of age.

³ Animals of all ages on Apr. 1, 1940, excluding horses, mules, and cattle under 3 months, pigs, goats, and chickens under 4 months, and sheep under 6 months. Comparable numbers in 1930 were 1,911 horses, 2,992 mules, 6,834 cattle, and 910 sheep. There were 3,585 hogs over 3 months of age in 1930.

TABLE 4.—*Value of agricultural products, by classes, in Marshall County, Ky., in stated years*

Crops and livestock products	1909	1919	1929	1939
Cereals, total.....	\$564, 446	\$1, 305, 369	\$442, 421	\$396, 352
Corn harvested for grain.....	(1)	(1)	421, 074	380, 023
Wheat threshed.....	(1)	(1)	18, 536	15, 762
Other cereals.....	(1)	(1)	2, 811	567
Other grains and seeds.....	147	1, 642	3, 284	1, 121
Hay and forage.....	101, 975	408, 314	176, 275	128, 230
Tobacco.....	(1)	(1)	382, 823	97, 151
Cotton.....	(1)	(1)	6, 501	7, 964
Vegetables, total.....	65, 982	228, 451	162, 403	92, 564
For sale ²	(1)	(1)	7, 283	1, 955
For home use ²	(1)	(1)	104, 956	71, 609
Potatoes and sweetpotatoes.....	(1)	(1)	50, 164	19, 000
Fruits and nuts.....	57, 279	130, 287	108, 798	222, 707
All other crops.....	461, 385	2, 699, 604	15, 557	6, 172
Forest products sold.....	(1)	(1)	11, 119	13, 017
Dairy products sold.....	14, 730	53, 102	155, 427	65, 389
Poultry raised and eggs produced.....	120, 941	221, 455	311, 155	128, 265
Livestock sold alive or slaughtered.....	288, 595	(1)	(1)	258, 584
Cattle and calves.....	(1)	(1)	(1)	85, 593
Hogs and pigs.....	(1)	(1)	(1)	171, 112
Sheep and lambs.....	(1)	(1)	(1)	1, 879
Wool shorn, mohair and goat hair clipped.....	1, 867	3, 150	1, 512	³ 552
Honey and wax produced.....	875	2, 720	⁴ 1, 665	⁴ 209

¹ Not available² Excluding potatoes and sweetpotatoes³ Wool only⁴ Honey only

TYPES OF FARMS AND LAND USE CHANGES

This part of Kentucky has been designated a tobacco-general farming area (15). Although the tobacco type of farming dominates in Marshall County, it is not so highly specialized as in other tobacco-growing areas of the State, and other types of farming are common.

Of the 2,182 farms in the county in 1940, all but 34 were classified by the Federal census according to their major source of income in 1939, as follows:

Farms with major source of income from—	Number
Farm products used by farm households.....	1, 478
Field crops.....	302
Fruits and nuts.....	161
Livestock.....	150
Dairy products.....	31
Poultry and poultry products.....	21
Forest products.....	5

The farms were also classified by size, as follows: 399 of less than 30 acres; 1,218, 30 to 99 acres; 421, 100 to 174 acres; 62, 175 to 219 acres; 71, 220 to 499 acres; 8, 500 to 699 acres; and 3, 700 to 999 acres. Most of the larger farms are on the Tennessee River bottoms and terraces, other large bottoms, and the very hilly uplands in the eastern part of the county.

The number of farms increased from 1,443 (74.6 percent of the county area) in 1880, to 2,281 (80.7 percent) in 1940, whereas the average size of farms decreased from 108 to 79.3 acres. Thus it appears that the great increase in the number of farms is mainly due to the subdivision of previously existing farms, with an accompanying reduction in the size of the individual units. The small size of farms is made possible by the importance of the tobacco crop and, to a less extent in recent years, by the strawberry crop, which affords a high cash return an acre and demands much family labor. Also, until after 1920, migration from the farms to large population centers was very limited.

The proportion of improved land in farms, including cropland and plowable pasture, increased from 38.6 percent in 1879 to 71 percent in 1939, and the acreage from 41.7 to 56 acres. About 21 percent of the farm land in 1939 was woodland.

FARM TENURE

In 1940 76.8 percent of the farms in the county were operated by owners and part owners and 23.2 percent by tenants. The proportion of tenancy is only 1.6 percent higher than in 1880. Farms are rented principally on the crop-share basis, only a very few being rented for cash. Under the prevailing rental system, the tenant furnishes the work animals, equipment, machinery, seed, and labor, and pays a third of the crop as rent.

FARM INVESTMENTS AND EXPENDITURES

In 1940 the average value of land and buildings was \$2,299 a farm and \$28.97 an acre. The average value of all farm property was \$2,750, of which land and buildings represented 83.4 percent, implements and machinery 4.6 percent, and domestic animals, poultry, and bees 12 percent.

The expenditure for fertilizer increased from \$953 in 1879 to \$44,023 in 1919 but decreased during the next two decades. In 1939 commercial fertilizer was purchased by 928 farms at a total cost of \$14,680, or an average of \$15.82 a farm. In addition, 3,562 tons of liming materials were purchased by 285 farms at a cost of \$7,216, or an average of \$25.32 a farm.

The total expenditures for farm labor increased from \$19,420 in 1899 to \$29,300 in 1919 and \$38,774 in 1939. In 1939, 448 farms, or 21 percent of the total, hired labor at an average expenditure of \$86.55. Farm labor is supplied almost wholly by local white people. Neighbors exchange work with each other for the tobacco, corn, wheat, and hay crops. Much hired labor, however, is required to pick strawberries and is supplied largely by local women and children, though some transient labor is used. Some labor also is hired to pick cotton.

The total amount expended for feed on farms increased from \$22,391 in 1909 to \$40,708 in 1939. In the latter year 893 farms, or 41 percent of the total, purchased feed at an average cost of \$45.60. Most of this feed was for chickens, hogs, and dairy cattle.

Farm equipment and machinery vary according to the character of the land in much the same way as do the farm buildings, but modern heavy farm machinery is uncommon. One- and two-horse machinery

predominate, but a few farms, especially on the river bottoms, have tractors and tractor machinery. The machinery of an average farm on the smoother uplands is: A two-horse walking plow, a two-horse home-made spike-toothed harrow or drag, a one-horse spike-toothed A-harrow, a one-horse home-made drag, a two-horse disk harrow, a corn planter, a two-horse disk cultivator, two double shovels, a one-horse bar plow, a small-grain drill, a mower, a hay rake, and a wagon. Many farmers use a one-horse corn planter and cultivate with one-horse implements. A number of farms do not have machinery for cutting wheat, and therefore people with harvesting machinery are hired for such work.

SOIL SURVEY METHODS AND DEFINITIONS

In making a soil survey the soils are examined, classified, and mapped in the field (9) and their characteristics recorded, particularly in regard to the growth of various crops, grasses, and trees.

The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings made, and highway or railroad cuts and other exposures studied. Each exposes a series of distinct soil layers, or horizons, termed collectively the soil profile. Each horizon, as well as the underlying parent material, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The chemical reaction of the soil and its content of lime and salts are determined by simple tests.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 upon the features that influence the adaptation of the land to the production of crop plants, grasses, and trees (10). On the basis of these characteristics the soils are grouped into classification units, the principal three of which are (1) series, (2) type, and (3) phase. Some areas that have little or no true soil—as Rough gullied land (Brandon soil material) and Gravel pit—are termed (4) miscellaneous land types.

The series is a group of soils having horizons similar in their important characteristics and arrangement in the profile. These horizons, or layers, usually are genetically related and derived from 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 soil may vary within a series. The series are given geographic names taken from localities near which they were first identified. Grenada, Calloway, and Brandon are names of important soil series in Marshall County.

Within a soil series are one or more types, differentiated 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,

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 precise neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the chemical reaction. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

silty clay loam, or clay—is added to the series name to give a complete name to the soil type. Brandon silt loam and Brandon gravelly loam are soil types within the Brandon series. Except for the texture, these types have approximately the same internal and external characteristics.

A phase is a subdivision of the type. Phases of a type differ from one another, generally with respect to external soil characteristics, such as slope or degree of erosion. For example, within the normal range of relief of a soil type some areas may be undulating and hence well adapted to the use of machinery; others may be rolling and less well adapted. Differences in relief and degree of accelerated erosion are the most common differentiating characteristics. The more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. Similarly, soils having differences in accelerated erosion may be mapped as eroded phases. Other differentiating phase characteristics are physiographic position, numbers of gravel or stones, accumulations of harmful salts, and alterations made by man.

Some soil types possess a narrow range of characteristics, and hence are not divided into phases. Such soil types could be thought of as consisting of only one phase. One of the phases of a soil type is generally of more common occurrence than the the others. Such a phase is considered to be the normal phase of the type and bears no phase designation. Brandon silt loam, for example, is divided into three phases in addition to the normal phase: (1) Brandon silt loam, undulating phase; (2) Brandon silt loam, rolling phase; and (3) Brandon silt loam, steep phase.

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

SOILS

The soils of Marshall County are similar in most respects to those of other counties in the Jackson Purchase area of Kentucky. In general they are medium to relatively low in natural fertility. They have developed in a mild temperate climate of moderately high rainfall, and this has allowed more rapid and more nearly continuous leaching than occurs in a cooler or drier climate, although leaching has not been so rapid as in the warmer, more humid climate farther south. Probably all the county was originally timbered (4). Principally because of these environmental conditions, only a relatively small quantity of organic matter accumulated in the soils, and much of it soon disappeared under cultivation. The soils are medium to very strongly acid, except on the first bottoms, where a few are slightly acid or neutral.

Except for a thin surface layer in undisturbed forests, where organic matter has accumulated, the soils are predominantly light-colored. The color is very closely related to the slope and drainage conditions, especially the natural or original drainage conditions under which the soils developed. The soils can be placed in four groups, depending on color of profile and related drainage conditions, as follows: (1) Naturally very poorly drained soils having light-gray surface soil

and subsoil, (2) naturally poorly drained soils having mottled-gray surface soil and subsoil, (3) imperfectly drained soils having grayish-brown surface soil, yellowish-brown or brown upper subsoil, and mottled-gray lower subsoil, and (4) well-drained soils having brown, light-brown, or grayish-brown surface soil and brown, yellowish-brown, or reddish-brown subsoil with no gray mottlings.

The soils of the uplands and stream terraces have important structure and consistence characteristics associated with these four groups. The naturally very poorly drained soils in the uplands and terraces have very compact and very slowly permeable subsoils, beginning at a depth of 10 to 15 inches. Compact very slowly permeable subsoil is commonly referred to as a "hardpan" or "claypan," and movement of water and air and penetration of roots in it are limited. The naturally poorly drained soils of the uplands and terraces have a similar claypan layer, but it occurs below a depth of 20 to 28 inches. The imperfectly drained soils of the uplands and terraces have a heavy lower subsoil layer that is less dense and compact and more permeable than that of the poorly drained soils. The well-drained soils do not have this development of a heavy compact gray or mottled-gray lower subsoil. This claypan layer in some stage of development is characteristic of about 42 percent of the area of the county, but it usually occurs in those soils of the uplands and terraces having the more suitable relief for growing cultivated crops.

The soil texture ranges from gravelly loam to silty clay loam, depending principally on the character of the parent materials from which the soils have developed. These materials include acid loess, unconsolidated Coastal Plain sandy, gravelly, and clayey materials, highly weathered cherty limestone materials, and Tennessee River alluvium. Loessal material has been the most important parent material from which the soils have developed. Soils having a silt loam texture have been produced from it and occupy approximately 75 percent of the county.

The slope, or lay of the land, erodibility, and degree of erosion are among the most important features that have determined the use of the land. Erodiability and degree of erosion vary with slope, kind of soil, the quantity, distribution, and intensity of the rainfall, and the practices of management, including the kind of crops grown, method of cultivation, and the length of time the land has been left bare or nearly bare of a protective vegetative cover. Where the slopes are about 2 percent or more and unprotected by a vegetative cover or other means, most of the soils are moderately to severely eroded.

The soil series are grouped largely on a basis of their suitability for use into four groups: (1) Brown soils of the smoother uplands and stream terraces, (2) gray soils of the uplands and stream terraces, (3) soils of the rougher uplands, and (4) soils of the flood plains.

BROWN SOILS OF THE SMOOTHER UPLANDS AND STREAM TERRACES

The brown soils of the smoother uplands and stream terraces are important agriculturally and comprise 39.2 percent of the area of the county. They are on nearly level to gently rolling relief and have slow to free external drainage. They have a brown, light-brown, or

grayish-brown predominantly silt loam surface soil and a yellowish-brown or reddish-brown upper subsoil. These soils are relatively low in content of organic matter and nitrogen, medium to strongly acid, and about medium in natural fertility.

The most prosperous farming communities are in the parts of the county where these soils predominate. The system of agriculture is fairly intensive, the farms are small, and the fields are rectangular and of medium size. The agriculture practiced consists mainly of the general-farm and the tobacco-fruit types. Utilization of a square mile of typical smoother uplands near Palma on which brown soils predominate is shown in plate 1, left. Corn, the most important crop in acreage, is grown for consumption on the farm. Tobacco and strawberries are the principal cash crops, and other cash income is derived chiefly from the sale of cotton, wheat, chickens, dairy products, and hogs.

The soil series represented in this group are the Grenada, Loring, Memphis, Providence, Brandon, Lexington, Bodine, Olivier, Scioto-ville, Wheeling, and Iola. All are on uplands except the last four, which are on stream terraces.

The Grenada, Loring, and Memphis soils were formed wholly from loessal material. The Grenada have a yellowish-brown friable upper subsoil underlain by mottled-gray moderately to very compact silty clay lower subsoil, slowly permeable to water; the Loring have an upper subsoil somewhat similar to that of the Grenada, but their lower subsoil generally is mottled brown slightly to moderately compact and fairly permeable silty clay loam; and the Memphis have a yellowish-brown to brown subsoil but no compact lower subsoil.

The Providence, Brandon, and Lexington soils were formed from a shallow covering of loessal material overlying gravelly or sandy Coastal Plain material at a depth of less than 42 inches. The Providence have a yellowish-brown friable upper subsoil and a mottled-gray moderately to slightly compact and slightly to moderately pervious lower subsoil; the Brandon and Lexington have a yellowish-brown to reddish-brown subsoil without a mottled compact lower layer, the Brandon containing gravelly Coastal Plain material, and the Lexington, sandy Coastal Plain material. The Bodine were formed from a shallow covering of loessal material over highly weathered cherty limestone material at a depth of less than 42 inches.

The Olivier soils are similar to the Grenada but were developed on stream terraces consisting chiefly of loessal material. The Scioto-ville and Wheeling soils were formed from old alluvium on terraces of the Tennessee River. The Scioto-ville differ from the Wheeling in having gray mottled slightly to moderately compact lower subsoil. The Iola is on stream terraces consisting of very gravelly materials.

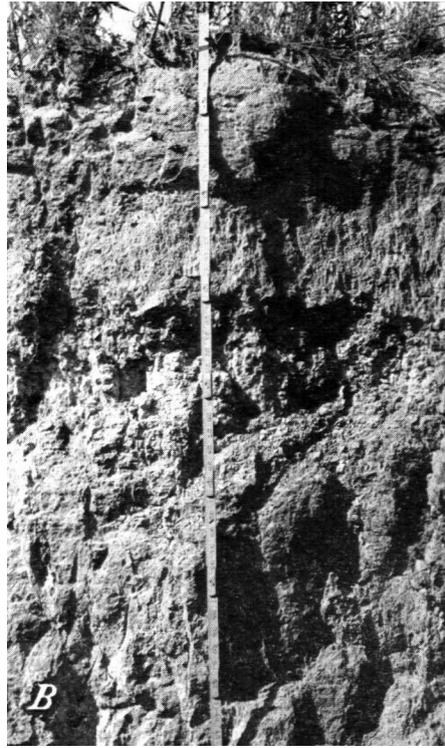
GRAY SOILS OF THE UPLANDS AND STREAM TERRACES

The gray soils of the uplands and stream terraces have a brownish-gray or mottled-gray silt loam surface soil and a gray or mottled-gray very compact dense claypan subsoil, or lower subsoil. In places the surface soil hardens on drying after rains, and the claypan, or lower subsoil, is very slowly permeable or almost impermeable to



UTILIZATION OF THREE TYPICAL SQUARE MILES OF SOILS IN MARSHALL COUNTY, KY.

Left: Smoother uplands near Palma, where brown soils predominate. *Middle:* Rougher uplands near Mount Carmel Church, including associated ridge tops and bottoms of small streams. *Right:* Bottom lands near Hardin, including small areas of adjoining stream terraces and uplands. Symbols *B*, Strawberries (including raspberries); *C*, Corn (including sorghum cane); *F*, farmsteads (includes orchards and vegetable gardens). *I*, idle open land (includes fields abandoned to brush); *J*, lespedeza, *R*, redtop (includes timothy); *S*, soybeans and cowpeas. *T*, Tobacco; *W*, wheat (includes rye, barley, and oats).



A, Cut in Bodine cherty loam near Eggner Bridge
B, Cut in Grenada silt loam near Enterprise School.
C. Profile of Brandon silt loam southeast of Brewers

water and not easily penetrated by roots. The organic-matter content is low, and the soils are strongly to very strongly acid. Relief is nearly flat to depressed, and surface drainage is slow to poor. The soils developed under forest consisting mainly of various oaks and hickory.

The soils of this group—representing the Henry, Calloway, Calhoun, Carroll, and Weinbach series—occupy 6.8 percent of the area of the county. The Henry and Calloway series are on smoother uplands and have developed from weathered loess, the Henry differing from the Calloway mainly in being lighter gray with few mottlings and in having a claypan layer much nearer the surface. The Carroll and Calhoun series have developed on terraces of smaller streams from old alluvium derived largely from loessal material, the Carroll differing from the Calhoun in being lighter gray and in having the compact dense subsoil much closer to the surface. The Weinbach soil was formed from old alluvium deposited principally by the Tennessee River.

Poor drainage greatly restricts the use of these soils for crops. Fair crop yields are obtained in normal seasons, but either wet or dry seasons are injurious to many crops. The present use of the soils is somewhat similar to that of the brown soils of the smoother uplands and stream terraces, though a much larger acreage is used for forest. These soils are not suited physically to deep-rooted crops.

SOILS OF THE ROUGHER UPLANDS

The soils of the rougher uplands occupy 27.2 percent of the county in widely scattered areas where the slopes range from about 5 to 40 percent. The soil series in this group are the Brandon, Providence, Memphis, Lexington, and Bodine. The Brandon, Providence, and Lexington soils have developed from a shallow covering of loessal material on Coastal Plain material, but the Coastal Plain material under the Brandon is gravelly, whereas that under the Lexington is sandy. The Providence differs from the other two series in having a mottled-gray slightly compact lower subsoil. The Memphis soils are developed wholly from loessal material, and the Bodine from a shallow covering of loessal material over highly weathered cherty limestone. Two miscellaneous hand types—Rough gullied land (Brandon soil material) and Gravel pit—are included in this group.

These soils are medium to strongly acid and are of low organic-matter content. They have free to excessive external drainage and, where unprotected, are subject to destructive sheet and gully erosion. They developed under an oak-hickory type of forest. The surface soil is brown, light brown, or grayish brown, and the upper subsoil is yellowish brown to reddish brown. The surface soil texture varies considerably from place to place.

Because of steep slopes, eroded condition, property of drying easily, or excessive gravel or chert fragments, only a small part of these soils is suitable for the production of field crops under existing economic conditions. In fields where erosion is not severe, some of these soils having milder slopes can be used for crops or permanent pasture, but where erosion is severe, the soils can be used best for forest. Only a small part of practically every soil is in field crops, mainly corn and lespedeza.

The utilization of a square mile of typical rougher uplands near Mount Carmel Church, including the associated smoother ridge tops and the bottoms along small streams, is shown in plate 1, middle.

SOILS OF THE FLOOD PLAINS

The soils of the flood plains, comprising 26.8 percent of the area of the county, are all developed on alluvial bottoms. They vary greatly in color, texture, drainage conditions, character of parent material, reaction, and organic-matter content. Many are subject to frequent overflow and thereby limited in suitability for crops. The Vicksburg, Shannon, Tigrett, Huntington, and Egam soils are well drained; the Collins, Hymon, Briensburg, and Lindside imperfectly drained; and the Waverly, Beechy, Dyer, and Melvin poorly drained. The utilization of a square mile of soils of the typical bottom lands near Hardin is shown in plate 1, right.

WELL-DRAINED SOILS

This group of well-drained soils of the flood plains comprises those soils of the alluvial bottoms that have good natural drainage. They have a brown, light-brown, or grayish-brown surface soil and a similar or somewhat lighter colored subsoil. They are subject to flooding, have good moisture relations, are rather high in inherent fertility, and are fairly well suited physically to corn. The system of agriculture practiced includes largely the growing of corn and small acreages of lespedeza, redtop, timothy, strawberries, soybeans, cowpeas, wheat, and tobacco. In many places corn is grown for several years in succession. Practically all the corn sold from the farms is grown on these soils. Fertilizer, lime, or manure are seldom used except for tobacco, but crop failures are rare.

Soils of the Vicksburg, Shannon, Tigrett, Huntington, and Egam series comprise this group. The Vicksburg soil is formed from loessal alluvium deposited on nearly level plains subject to the usual overflow, and the Shannon from alluvium consisting of both Coastal Plain and loessal materials in nearly flat flood plains subject to overflow from adjacent streams. The Tigrett soils are formed from local alluvium and colluvium washed from Grenada, Loring, Memphis, Providence, Brandon, Lexington, and Bodine soils, either separately or in various combinations. They are gently sloping and very gently sloping and are not flooded by the usual overflow of streams. The Huntington and Egam soils are formed from general alluvium deposited mainly by the Tennessee River; the Huntington have a friable subsoil, and the Egam a somewhat compact tough heavy-textured subsoil.

IMPERFECTLY DRAINED SOILS

This group of imperfectly drained soils of the flood plains comprises all the soils of the flood plains having imperfect or intermediate natural drainage. The series represented are the Collins, Hymon, Briensburg, and Lindside soils. The Collins is formed from alluvium derived largely from loessal material and occupies positions on nearly level flood plains subject to flooding; the Hymon is formed from alluvium consisting of Coastal Plain sand and gravel and loessal mate-

rial and occupies nearly level flood plains overflowed by adjacent streams from time to time. The Briensburg are formed from local alluvium and colluvium of loessal material, Coastal Plain material, or both. They are very gently sloping to gently sloping and are not inundated by the usual overflow of streams. The Lindsides are formed from general alluvium deposited mainly by the Tennessee River. These soils have a brown, light-brown, or grayish-brown surface soil and a mottled-gray subsoil.

As on the well-drained group of soils, corn is the best adapted crop for these soils, and in the system of agriculture practiced it is the principal crop, there being only small acreages of others. The crops are more likely to be damaged by wet weather than those on soils of the well-drained group, and the yields are slightly less.

POORLY DRAINED SOILS

This group of poorly drained soils of the flood plains—representing the Waverly, Beechy, Dyer, and Melvin series—comprises all the soils having poor natural drainage. The Waverly was formed from alluvium composed largely of loessal material, and the Beechy from alluvium composed of both Coastal Plain and loessal materials. They are on flood plains of creeks and small rivers. The Dyer is formed from local alluvium and colluvium consisting of both loessal and Coastal Plain materials and rarely is inundated by floods. The Melvin are formed from alluvium deposited mainly by the Tennessee River. All these soils are mottled-gray with grayish brown, rusty brown, and yellow throughout the profile.

As on the well-drained and imperfectly drained soils of the flood plains, corn is the principal crop. Small acreages are in redtop, lespezeza, tobacco, soybeans, and wheat. A higher percentage of these soils is in forest and pasture than of either of the other two groups of the flood plains. In forested areas the trees are predominantly Southern red, black, pin, willow, and swamp chestnut oaks, silver and red maples, winged elm, sweetgum, river birch, sycamore, and hickory. Cypress, willow, and water tupelo predominate in the permanently wet areas.

Because of their poor natural drainage these soils are not well suited to growing field crops. During favorable seasons good yields may be obtained on some, but during very wet seasons part or complete failure of crops is common on all. Artificial drainage would greatly benefit these soils.

DESCRIPTIONS OF SOIL UNITS

In this county the soils are mapped and classified in 58 soil units, representing 29 series and consisting of 40 types, 16 phases, and 2 miscellaneous land types. In the following pages the soils are described in detail and their agricultural relations discussed. Their location and distribution are shown on the accompanying map, and their acreage and proportionate extent are given in table 5.

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

Soil type	Acres	Percent
Beechy loam.....	5, 504	2. 5
Sanded phase.....	128	. 1
Bodine cherty loam.....	1, 728	. 8
Bodine loam.....	1, 792	. 8
Undulating phase.....	704	. 3
Brandon gravelly loam.....	8, 768	4. 1
Brandon silt loam.....	20, 288	9. 4
Rolling phase.....	1, 664	. 8
Steep phase.....	15, 936	7. 4
Undulating phase.....	2, 624	1. 2
Briensburg loam.....	7, 680	3. 6
Briensburg silt loam.....	1, 536	. 7
Calhoun silt loam.....	1, 792	. 8
Calloway silt loam.....	1, 472	. 7
Carroll silt loam.....	1, 408	. 7
Collins silt loam.....	6, 080	2. 8
Dyer silt loam.....	960	. 4
Egam silty clay loam.....	1, 600	. 7
Gravel pit.....	64	(¹)
Grenada silt loam.....	26, 752	12. 4
Level phase.....	7, 616	3. 5
Henry silt loam.....	128	. 1
Huntington fine sandy loam.....	256	. 1
Huntington silt loam.....	896	. 4
Hymon loam.....	7, 168	3. 3
Iola gravelly loam.....	256	. 1
Lexington loam.....	1, 088	. 5
Steep phase.....	2, 176	1. 0
Lexington silt loam.....	960	. 4
Rolling phase.....	512	. 2
Undulating phase.....	768	. 4
Lindside silt loam.....	704	. 3
Lindside silty clay loam.....	448	. 2
Loring silt loam.....	8, 256	3. 8
Rolling phase.....	6, 656	3. 1
Melvin silt loam.....	1, 600	. 7
Melvin silty clay loam.....	1, 024	. 5
Memphis silt loam.....	832	. 4
Hilly phase.....	704	. 3
Undulating phase.....	3, 520	1. 6
Olivier silt loam.....	1, 408	. 7
Undulating phase.....	896	. 4
Providence silt loam.....	10, 048	4. 6
Hilly phase.....	3, 392	1. 6
Rough gullied land (Brandon soil material).....	2, 048	. 9
Sciotoville silt loam.....	6, 208	2. 9
Slope phase.....	1, 216	. 6
Sciotoville very fine sandy loam.....	640	. 3
Shannon loam.....	3, 200	1. 5
Tigrett cherty loam.....	384	. 2
Tigrett loam.....	5, 568	2. 6
Vicksburg silt loam.....	3, 584	1. 7
Waverly silt loam.....	9, 856	4. 5
Weinbach silt loam.....	9, 792	4. 5
Wheeling loamy fine sand.....	128	. 1
Wheeling silt loam.....	1, 600	. 7
Slope phase.....	1, 024	. 5
Wheeling very fine sandy loam.....	1, 280	. 6
Total.....	216, 320	100. 0

¹ Less than 0. 1 percent.

Beechy loam.—This fairly important agricultural soil has formed under conditions of poor drainage from alluvium composed of both Coastal Plain and loessal materials similar to those that have given rise to Hymon loam. Its external and internal drainage, probability of being flooded, and other moisture relations are similar to those of Waverly silt loam. Covering a total of 5,504 acres on nearly level flood plains of many of the creeks and smaller rivers, it is generally at some distance from the stream channels and is termed “white land,” “buckshot land,” or “crawfishy land.”

The 5- to 10-inch surface soil is brownish-gray or mottled-gray, grayish-brown, and rusty-brown mellow loam, or other medium texture. This is underlain by light-gray mottled with grayish-brown, rusty-brown, and yellow friable soil material, generally stratified loam, silt loam, fine sandy loam, loamy sand, or gravelly loam, to a depth of several feet. The entire soil is strongly acid and contains many dusky reddish-brown soft to hard iron concretions. Many pebbles are in a few places, and an appreciable quantity of small mica flakes is in some places, especially along Jonathan Creek. In wooded areas the first inch or two of the profile is somewhat darker colored because of a moderate accumulation of organic matter.

The present use, suitability for crops, and suggested management of this soil are the same as for Waverly silt loam, except that a smaller acreage is planted to corn and a larger acreage is idle open land. The crop yields, however, are 5 to 10 percent less, owing to the lighter texture and somewhat lower inherent fertility.

Beechy loam, sanded phase.—This phase is formed by the deposition of coarse-textured sandy or sandy gravelly materials washed from stream channels onto the normal phase^o of the type. It is a poorly drained unimportant agricultural soil covering a total area of only 128 acres where stream channels have practically no gradient or have become filled with sand, pebbles, or other materials, causing the streams to spread over the adjoining land. Most of the areas either have no definite channel or have several small channels instead of the original.

The overwash consists of a layer of yellowish-, brownish-, or reddish-colored loose sand or sandy gravelly material 2 to 20 inches thick or more. Its characteristics vary considerably from place to place, and in places the soil is stratified. In a few areas the underlying soil consists of Waverly silt loam.

Most of this phase has been cleared, but none is used for field crops. Most areas have a growth of brush, consisting mainly of willow, sweetgum, silver and red maples, river birch, and buttonbush. A growth of cattails and water-tolerant sedges and grasses grow in some places. Under its present drainage condition this phase is better suited to pasture.

Mapped with this soil are a few areas in which the original bottom land is covered by wash from severely gullied hillsides nearby.

Bodine cherty loam.—This soil, occupying a total area of 1,728 acres, is similar to Bodine loam in parent material, mode of occurrence, relief, drainage, erosion, reaction, and main profile characteristics, but differs in being cherty. The relief is hilly to steep, the slope

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

being 18 to 40 percent or somewhat more, but because of chert fragments on the surface the soil is somewhat less eroded than Bodine loam. Heavy agricultural machinery cannot be used well.

Large quantities of angular chert fragments as much as 10 inches in diameter are on the surface and in varying quantities in the surface soil and subsoil. Many of the steeper slopes, especially those facing south and west, are practically covered with chert fragments, but on slopes facing north and east the quantity generally is somewhat less. In most places the extremely cherty substratum is reached at less depth than in Bodine loam (pl. 2,4).

About 80 percent of this soil is in forest, and most of the rest is idle open land. Practically none is planted to field crops. Owing to the steepness, chertiness, relatively low water-holding capacity, and relatively low inherent fertility, its most feasible use is forest.

Mapped with this soil is a total area of about one-fifth square mile with a slope of 10 to 18 percent.

Bodine loam.⁷—This soil has developed on uplands from a thin covering of loessal material over weathered material of cherty limestone. It is hilly to steep, having slopes of 18 percent or more, though mostly less than 40 percent. External drainage is excessive, and internal drainage is good in the upper part but slow in the extremely cherty substratum, which is weakly cemented in places. The soil tends to dry out readily and if unprotected is subject to very severe sheet and gully erosion, though the cherty substratum prevents gullies from becoming very deep. In cultivated areas 4 inches or somewhat more of the original surface soil has been removed by accelerated erosion. About 8 percent of the total area has been moderately gullied and 5 percent severely gullied. Heavy farm machinery cannot be used satisfactorily. A total of 1,792 acres of this soil is mapped. The areas are confined to a belt 3 miles wide or less on the rougher uplands in the eastern part of the county adjacent to terraces and bottom lands of the Tennessee River between the Marshall-Calloway County line and Gilbertsville.

Under virgin conditions the surface soil to a depth of about half an inch is dark-colored loam underlain to a depth of 5 or 6 inches by grayish-brown loam, which, in turn, is underlain to a depth of about 10 inches by light-brown or yellowish-brown heavy-textured loam. Underlying this to a depth of 20 to 30 inches is bright yellowish-brown, tinged with brown in many places, slightly compact and somewhat friable clay loam or silty clay loam subsoil. The surface soil and subsoil contain some small angular chert fragments that become somewhat more numerous with depth. Beneath the subsoil is a slightly to moderately compact mass of angular chert fragments filled between by mottled-gray and yellowish-brown light-textured clay loam. This cherty mass continues to a depth of several feet and contains calcareous material in only a few places. The entire profile is strongly to medium acid and contains a few small soft dusky reddish-brown or dark-colored iron concretions in most places.

Probably 64 percent of the total area of this soil is in forest, 34 percent is idle open land, and 2 percent is used for farmsteads and crops,

⁷ Bodine soils, now restricted entirely to Lithosols, were much more broadly defined at the time this survey was made and included soils showing Planosolic characteristics.

mainly corn and lespedeza.⁸ Crop yields are very low, probably about equal to those of Brandon silt loam, steep phase. Steepness, severe erosion, and quality of drying out readily render this soil unsuitable for crops and best suited to forest.

Mapped with this soil are areas in which the surface soil is silt loam and the soil more or less cherty, the quantity of chert fragments on and in the profile being greatest where the slopes face south and west. The presence of chert fragments on the surface in unusually large quantities is indicated on the map by symbols. Also included is a total of about 1 square mile of Bodine loam of milder slope (10 to 18 percent), the relief generally being strongly rolling. This included soil is in the same belt as the normal phase of the type and is similar to that soil except in its milder slope, slightly deeper surface soil, and somewhat heavier textured subsoil. External drainage is free and internal drainage good in the upper part but, because of the extremely cherty substratum, slow in the lower part. This soil has a rather low water-holding capacity and when not properly managed, is subject to erosion. Perhaps 13 percent of its total area has been moderately gullied and 8 percent severely gullied. The soil is not well suited to the heavier types of farm machinery. Use, suitability for crops, crop yields obtained, and suggestions for the use and management of this included soil are the same as for Brandon silt loam.

Bodine loam, undulating phase.—This soil differs from the normal phase of the type principally in having gently undulating to gently rolling relief (2- to 10-percent slope), which causes differences in drainage, erosion, and depth of surface soil. External drainage is good to free, but because of the compactness of the lower subsoil and the extremely cherty substratum internal drainage is medium to moderately slow. When not protected the soil is subject to moderate to severe sheet and gully erosion. The surface soil generally is slightly deeper, the gray mottled lower subsoil somewhat more compact, and in most places depth to the cherty substratum greater than in the normal phase. A total of 704 acres occurs in relatively small areas in the hilly eastern part of the county, principally on long narrow ridge tops.

Probably 40 percent of this soil remains in forest, 46 percent is idle open land, 5 percent is used for corn, 3 percent for lespedeza, and the rest for farmsteads and minor crops. Under the usual farming practices corn yields about 20 bushels an acre, wheat 10 bushels, cotton 200 pounds, lespedeza 0.6 ton of hay, and tobacco, about 650 pounds. The suitability for crops and the suggestions for management of this soil are similar to those for Loring silt loam and its rolling phase, the management depending on the character of relief.

Mapped with this phase are a few areas in which the surface soil contains a large quantity of angular chert fragments and in places silt loam instead of loam. These cherty areas are indicated on the soil map by symbols.

Brandon silt loam.—This soil is developed on uplands from loessal material overlying stratified gravelly Coastal Plain material at a

⁸ The percentage of the total area of each soil in different crop use is based on estimates from maps of selected areas showing the cover on the land. These maps, made during the progress of the field work, include about 12 percent of the total area of the county.

depth of less than 42 inches. It ranks second in extent, covering a total of 20,288 acres throughout most of the rougher uplands. The relief is strongly rolling to hilly, the slope ranging from 10 to 18 percent. External drainage is free, and the subsoil is porous enough to allow good percolation of water, but in some places water and roots are checked by the cemented gravel in the profile. In places where the gravel substratum is loose or near the surface, crops are injured easily by drought. When unprotected the soil is subject to very severe sheet and gully erosion, and where the customary cultivation has been practiced for several years, two-thirds or more of the original surface soil has been removed by sheet erosion. About 13 percent of the soil has been moderately gullied and 8 percent severely gullied, although gullies generally do not become so large as in the Lexington soils. Ordinary agricultural machinery may be used, but the use of heavier types is difficult.

Under virgin conditions the surface soil to a depth of $\frac{1}{2}$ to 1 inch is dark grayish-brown mellow silt loam. This overlies about 3 inches of light grayish-brown mellow silt loam that grades into light-brown to pale yellowish-brown mellow silt loam continuing to a depth of 6 to 8 inches. (In uneroded cultivated areas the plowed layer consists of light grayish-brown silt loam.) At a depth of 11 to 13 inches the upper subsoil of yellowish-brown friable heavy-textured silt loam grades into bright yellowish-brown, tinged with brown, silty clay loam or clay loam. The subsoil throughout is slightly compact and somewhat friable and in most places contains a few rounded pebbles. Below a depth of about 22 inches it becomes more pebbly and at a depth of 24 to 40 inches gives way to light-brown, yellowish-brown, or reddish-brown stratified gravel containing interstitial clay and sand. In places faint-gray mottlings are in the interstitial material of the upper part. The gravel is slightly to moderately compact but generally unconsolidated (pl. 2, C). The pebbles are well rounded, as much as 5 inches in diameter, and are composed mainly of chert, but some are of quartz. In places lenses or layers in the gravel are cemented by ferruginous material into conglomerate rocks. Depth of the loessal material of the profile to the gravel stratum and number of pebbles in the subsoil vary considerably from place to place. The soil is strongly to medium acid throughout.

Probably 25 percent of this soil is in forest, 4 percent is used for corn, 2 percent for lespedeza, 3 percent for other crops, 2 percent for farmsteads, and 64 percent is idle open land. Most of the idle open land is cropland no longer cropped, and nearly two-thirds of it has a growth mainly of persimmon, sassafras, wild plum brush, and sumac bushes. Some is pasture land, but pastures generally are very poor, consisting mainly of volunteer common lespedeza and weeds. Except on newly cleared land crop yields are very low. Under common management, including the use of very little lime and fertilizer, corn yields about 7 bushels; lespedeza, 0.2 ton of hay; and wheat, 3 bushels an acre.

Most of the merchantable timber has been cut, leaving principally white, black, blackjack, and red oaks, and some dogwood, hickory, shingle and post oaks, chestnut, and beech trees.

Because of strong slope, fairly low water-holding capacity, and eroded condition or probability of destructive erosion, this soil is un-

suitable for field crops under prevailing economic conditions, and its best use is for pasture and forest. Where not gullied or severely sheet-eroded, it can probably be used well for permanent pasture, but it is advisable to construct terraces or to furrow along the contour and apply lime and phosphate. If such practices are followed, pasture consisting of a mixture of lespedeza, hop clover, alfalfa, sweet-clover, orchard grass, redbtop, and Canada bluegrass should be suitable; alfalfa alone also should produce fairly well. When the soil is gullied or severely sheet-eroded its best use is for forest, and that part already forested should remain so.

Brandon silt loam, undulating phase.—Although this phase is similar to the normal phase of the type in all significant profile characteristics, including the parent material, it differs in having a gently undulating relief (2- to 5-percent slope), which causes differences in drainage, erosion, and depth of surface soil. Both external and internal drainage are good. The soil is subject to harmful sheet erosion and slight gullying, and the present erosion conditions are similar to those of Memphis silt loam, undulating phase. The surface soil is slightly deeper, the subsoil slightly heavier textured, and the gravelly substratum is generally at a slightly lower depth than in the normal phase. A total of 2,624 acres is mapped, principally near the ends of long narrow ridge tops in the hilly eastern part of the county.

About 40 percent of this phase is in forest, 5 percent is used for corn, 5 percent for lespedeza, 9 percent for farmsteads, 1 percent each for cotton, strawberries, tobacco, wheat, soybeans, and redbtop, and 35 percent is idle open land. The suitability of this soil for crops is somewhat similar to that of Memphis silt loam, undulating phase, but the crop yields are much lower because of the gravelly substratum and greater injury to crops by droughts. Under common management corn yields about 20 bushels an acre; wheat, 10 bushels; cotton, 230 pounds; strawberries, 55 crates; lespedeza, 0.6 ton of hay; and tobacco, 625 pounds. Under good management practices including proper applications of lime and fertilizer, corn yields about 30 bushels an acre; wheat, 13 bushels; strawberries, 65 crates; cotton, 320 pounds; and lespedeza, 1.1 tons of hay.

Suggestions for the use and management of this soil are similar to those for Grenada silt loam.

Brandon silt loam, rolling phase.—In all significant profile characteristics, including parent material, this soil is similar to the normal phase of the type, but it differs in being on gently rolling slopes (5 to 10 percent), which cause differences in drainage, erosion, and depth of surface soil. Drainage is good to free, and the soil tends to become dry rather quickly. It is subject to severe sheet and gully erosion, and its condition of erosion is the same as in Providence silt loam. Eroded areas are indicated on the soil map by symbols. A total of 1,664 acres of the soil is mapped, principally at the ends of long narrow ridge tops and near the source of drainageways in the hilly eastern part of the county.

About 28 percent of this soil is in forest, 5 percent is used for lespedeza, 3 percent for corn, 3 percent for farmsteads, 1 percent for wheat, 57 percent is idle open land, and the rest is used for minor crops. The soil is rather poorly suited to crops, owing to its suscepti-

bility to severe erosion and to the quality of drying readily. Under the common management practices corn yields about 12 bushels an acre; wheat, 8 bushels; cotton, 170 pounds; and lespedeza, 0.4 ton of hay.

Suggestions for the management of this soil are the same as for Loring silt loam, rolling phase.

Brandon silt loam, steep phase.—This soil is the third largest in area of the soils of the county, having a total extent of 15,936 acres scattered over most of the rougher uplands. It is similar to the normal phase of the type in significant profile characteristics, nature of parent material, and most other features but differs in that it occurs in hilly and steep areas where the slopes are between 18 and 40 percent, has greater runoff, absorbs less rainfall, dries out sooner, and under cultivation is more subject to accelerated erosion. Perhaps 8 percent of its total area is moderately gullied, and 5 percent severely gullied. Heavy farm machinery cannot be used satisfactorily.

The surface soil generally is shallower and the subsoil somewhat lighter textured than in the normal phase. Content of pebbles and depth to the gravelly substratum vary. In general this depth is less than in the normal phase, but it varies from place to place and generally is greater on the upper slope than on the lower.

About 68 percent of this steep phase is in forest, 29 percent is idle open land, and 3 percent is used for farmsteads and for crops, mainly lespedeza, corn, and strawberries. Crop yields are very low, probably a third lower than on the normal phase. This phase apparently can be best used for forest, as it is too steep, too eroded, and dries out too readily for feasible crop use.

Included with this soil as mapped are many small areas in which a few to a large number of pebbles are on the surface and in the surface soil, especially on slopes facing south and west.

Brandon gravelly loam.—When unprotected this soil is subject to very severe erosion. Its present condition of erosion is similar to that of Brandon silt loam. It differs from that soil chiefly in having a shallower covering of loessal material, more pebbles on and in the soil, and more brown or reddish brown in the subsoil. The relief (10- to 40-percent slope) is mostly hilly and steep, but some is strongly rolling. A total area of 8,768 acres is mapped, about one-tenth of a square mile of which is gently rolling (less than 10-percent slope). External drainage is free to excessive and internal drainage good to excessive. The soil is medium to strongly acid and low in organic-matter content.

In forests the surface soil to a depth of about half an inch is dark grayish-brown gravelly loam containing partly decayed leaves and twigs, largely from oak trees. Below this, to a depth of 6 inches, the surface soil is light grayish-brown gravelly loam, below which to a depth of about 12 inches is yellowish-brown gravelly loam, passing into a brown or reddish-brown heavy-textured more or less friable gravelly loam or gravelly clay loam subsoil that is sticky and plastic when wet. Below a depth of 24 to 30 inches the texture is lighter, and the pebbles become more numerous, gradually giving way to stratified gravel with clay and sand in the interstices.

This soil varies considerably in physical properties from place to place because of variation in thickness of the loessal cover and in the

nature of the underlying stratified Coastal Plain material. Here and there, strata of sandy material underlie gravelly strata or are interstratified with them and may outcrop at any position on the slope, producing gravelly sandy loam or gravelly loamy sand surface soil. The subsoil in these places may be gravelly clay loam, gravelly loamy sand, or practically nongravelly material. The pebbles on the surface vary in number, generally being much more numerous on south and west slopes. These pebbles, largely chert with some quartz, are well rounded and as much as 5 inches or more in diameter, the larger ones being in the eastern part of the county. The gravelly strata are loose to moderately compact and generally unconsolidated, though in many places lenses or layers cemented by ferruginous material produce a conglomerate rock. Outcrops of this rock several feet thick appear on steep slopes and are indicated on the map by escarpment symbols.

Approximately 78 percent of this soil is forested, 19 percent is idle open land, and 3 percent is used for crops and homesteads, the main crops being corn, wheat, and lespedeza. Crop yields are relatively very low. As the soil is generally hilly and steep, subject to severe erosion, generally gravelly, of low inherent fertility, and dries out readily, its feasible use is for forest.

Briensburg silt loam.—This recent to young soil is developed under fair drainage conditions from local alluvium and colluvium composed of material washed from soils underlain by loessal material. It is similar to the Tigrett and Dyer soils in mode of occurrence but intermediate between them in profile characteristics, natural drainage condition, and agronomic relations. In profile characteristics it is similar to Collins silt loam except for its somewhat more variable texture, but differs in occupying gently sloping areas at the base of hills, very gently sloping alluvial fans of small streams flowing onto flood plains of larger creeks, and narrow bottoms along deeply entrenched stream beds.

The soil is not inundated by ordinary flooding, but in some places it may be covered for a brief period after exceptionally heavy rains. External drainage is slow to good, and internal drainage is moderately slow to slow because of a fairly high intermittent water table. If the water table were permanently lowered by underdrainage, internal drainage would be good. The soil has fairly good moisture-holding capacity, and the moisture supply available to crops during drought is relatively high. A total area of 1,536 acres is mapped, principally in the northern and southwestern parts of the county.

Since this soil is less likely to be overflowed, it is better suited than Collins silt loam to a wider variety of crops. Under the common practices of management, in which no lime or fertilizer is used, corn yields about 38 bushels an acre; strawberries, 95 crates; and cotton, 240 pounds. Under good management practices, including the use of lime and phosphate, corn yields about 50 bushels an acre; strawberries, 120 crates; and cotton, 440 pounds. Tobacco yields about 950 pounds an acre when the land is treated with a complete fertilizer. This is probably the best soil in the county for strawberries, raspberries, and vegetables. The use, suitability for crops, and suggestions for management of this soil are similar to those for Tigrett loam, but largely because of the higher content of moisture, yields of corn,

strawberries, and hay crops, except deep-rooted legumes, are slightly higher.

Briensburg loam.—Covering a total of 7,680 acres scattered throughout most of the county, this soil is one of the most extensive soils of the bottom lands. It is derived from local alluvium and coluvium composed of both Coastal Plain and loessal materials and is similar to Briensburg silt loam in all respects except parent material and texture. In general, it contains enough sand for its texture to be loam; however, the texture varies considerably from place to place and is silt loam, fine sandy loam, loamy sand, or gravelly loam. Stratification of friable material of different textures is common beneath the surface soil, and in places there are gravelly areas, which are indicated on the soil map by symbols.

This soil is not so productive as Briensburg silt loam, the crop yields being 5 to 10 percent less; otherwise, the agronomic relations of the two soils are practically the same.

Calhoun silt loam.—This soil has developed on stream terraces under poor drainage conditions from old alluvium derived mainly from loess. The relief is depressed, flat, or very gently sloping, the slope in most places being less than 2 percent. The soil areas lie 1 to 10 feet above the bottom lands and are above the usual overflow of adjacent streams. A total of 1,792 acres is mapped, largely along the East Fork Clarks River near Benton, Hardin, and Elva.

In profile characteristics, moisture relations, drainage, and condition of erosion this soil is similar to Calloway silt loam, but it differs mainly in parent material, development on stream terraces, and the occurrence of a compact very slowly permeable lower subsoil in places at a slightly shallower depth. In the vicinity of Elva the areas contain some small mica flakes and probably more phosphorus than is common.

The present use, cropping suitability, suggested management, and crop yields are similar to those of Calloway silt loam, though the yields probably average slightly less.

Calloway silt loam.—This soil, developed under poor drainage conditions from loessal material on the smoother uplands, is commonly called "buckshot land" and "gray land." It is intermediate between the Grenada and Henry silt loams in color, condition of drainage, claypan development, use, suitability for crops, and productivity. The relief is nearly level to slightly depressed (2-percent slope or less), and external drainage is slow to poor. The soil covers a total of 1,472 acres, the larger areas being southwest of Benton, west of Hardin, and near Van Zora School, Palma, and Briensburg.

Under virgin conditions the upper half inch of the surface soil is somewhat dark-colored and contains considerable organic matter in varying stages of decomposition. In cultivated areas the 5- or 6-inch surface soil is brownish-gray mellow silt loam, mottled more or less with gray, rusty brown, and yellow, but is light gray when dry. Beneath this to a depth of 22 to 30 inches is a highly mottled gray, brownish-gray, yellow, and rusty-brown very friable silt loam layer, somewhat less intensely mottled and somewhat heavier textured in the lower part. This layer is underlain by about a 2-inch layer characterized by much whitish-gray and ashy-colored silty material,

especially between the soil aggregates and in root channel. This gives way abruptly to a medium-gray very compact and dense claypan of silty clay loam or silty clay, which is somewhat mottled with rusty brown and yellow, breaks down into large hard subangular aggregates, and is very plastic and sticky when wet. Below a depth of about 45 inches the profile is brownish-yellow, with some gray and rusty-brown, massive and compact light-textured silty clay loam or silt loam. Gravelly, sandy, or clayey Coastal Plain material lies below a depth of 60 to 120 inches.

The layers above the claypan permit fairly good absorption and percolation of water, but the claypan is very slowly permeable to water and in rainy seasons causes the soil to be very wet and water to stand. Partial failure of crops, especially tobacco and wheat, may result from too much moisture. During prolonged dry weather crops suffer more than on soil of more favorable internal characteristics. The claypan prevents good aeration of the profile and is only slightly pervious to roots, restricting considerably the growing of deep-rooted crops.

Many to very many dark-colored or dusky reddish-brown soft to hard iron concretions are throughout the profile but are most numerous above the claypan layer. Many semihard to hard iron pellets or concretions are on the surface, giving rise to the name "buckshot" for this soil. With the exception of the slightly to medium acid thin dark-colored upper layer and the substratum below a depth of about 72 inches, the profile is very strongly acid.

About 33 percent of this soil is in forest, 18 percent is used for corn, 7 percent for redtop, 6 percent for lespedeza, 2 percent each for wheat, strawberries, soybeans (including cowpeas) (pl. 3, A), sorghum cane, and tobacco, 3 percent for farmsteads, and 23 percent is idle open land.

Under common farm practices corn yields about 20 bushels an acre; wheat, 8 bushels; strawberries, 55 crates; and lespedeza, 0.8 ton of hay. With liming, proper fertilization, and other good soil management, corn yields about 30 bushels an acre; wheat, 12 bushels; strawberries, 70 crates; and lespedeza, 1.4 tons of hay. In favorable seasons with fertilization tobacco yields of fairly good quality average 925 pounds an acre. Redtop, cowpeas, and soybeans produce fairly well. Cotton, alfalfa, red clover, and fruit trees are not well adapted, but the sorghum grown makes very good quality sirup.

Artificial drainage is one of the most important measures in the management of this soil, though practically no attempt has been made to drain the soil. Adequate drainage probably can be best obtained by open ditches and bedding, but tile may be used to drain some areas. Other practices of management involve rather heavy liming, the incorporation of organic matter from barnyard manure, green manure, and crop residues, applications of phosphate and potash fertilizers, and crop rotations that include legumes.

Carroll silt loam.—This soil, formed on stream terraces under conditions of very poor drainage from old alluvium derived mainly from loess, is similar to Henry silt loam in most profile characteristics. It differs from Calhoun silt loam in having a lighter gray color and a compact and very slowly permeable claypan layer within 15 inches of the surface. The total area of 1,408 acres occurs in relatively large

areas on the terraces of the East Fork Clarks River in the vicinity of Elva. Relief is practically level, the slope being less than 1 percent. Both external and internal drainage are poor to very poor, and water stands on the surface in some areas for a considerable time in wet seasons. The soil lies above the usual overflow of the adjacent stream but is inundated by very high floods. Crops on this soil do not withstand drought well, and the subsoil is very slowly pervious to roots.

Under virgin conditions the surface soil to a depth of about 2 inches is brownish-gray to light-gray friable silt loam, which is underlain by light-gray to very light-gray friable silt loam or heavy-textured silt loam containing some yellow mottlings. At a depth of 9 to 13 inches this layer passes into a medium-gray clay or silty clay, somewhat mottled with yellow and yellowish brown, very compact, dense, tough, and tenacious subsoil that is very sticky and plastic when wet. This claypan breaks into hard fairly large angular nutlike particles coated with a whitish-gray silty material in the upper part of the layer, and at a depth of 35 to 45 inches it is somewhat lighter textured and less compact, dense, and tenacious. Below a depth of about 55 inches is light-brown, mottled with gray and yellowish-brown, moderately compact silty clay loam. The substratum, beginning at a depth of about 60 inches, is old alluvium, generally medium-textured and in places stratified.

Small dark-colored iron concretions occur in varying quantities throughout the slightly micaceous profile. The surface soil and subsoil are very strongly to strongly acid, whereas the substratum may be only slightly acid or neutral.

Because of the compact and very slowly permeable subsoil and unfavorable moisture relations, most of the crops commonly grown are poorly adapted to this soil. About 80 percent of the soil is in forest, consisting of post oak and some pin, swamp chestnut, and Southern red oaks, and hickory trees; only a small acreage is used for crops, mainly corn, sorghum cane, cowpeas, soybeans, and redtop; and the rest is idle open land. The average acre yields of crops are very low, that of corn being about 7 bushels on undrained areas not treated with lime or fertilizer. Sorghum cane does fairly well, producing a good quality of molasses. Cowpeas, soybeans, and redtop yields are fair to poor. One farmer reported that a few crops of strawberries have been grown with fair results. Crop failures are frequent, either in very wet or very dry seasons.

Although only fair for forest, this soil is probably best used for that purpose; if used for crops, the same management practices suggested for Henry silt loam will apply to this soil.

Collins silt loam.—This recent or young soil is formed on nearly level flood plains of creeks and smaller rivers under conditions of fair drainage from alluvium composed largely of loessal material and is one of the most important soils of the bottom lands. Its total area of 6,080 acres is mapped along the East Fork and West Fork Clarks Rivers and some of their tributaries. It differs from Vicksburg silt loam in having poorer drainage and a gray mottled subsoil above a depth of about 36 inches. In profile characteristics, drainage conditions, and agronomic relations it is intermediate between Vicksburg and Waverly silt loams.

The upper layer of this soil consists of light-brown or slightly grayish-brown mellow silt loam, which is underlain at a depth of about 7 inches by light-brown or slightly yellowish-brown friable silt loam. At a depth of 10 to 30 inches the subsoil is mottled medium-gray, grayish-brown, yellow, and rusty-brown friable silt loam, the gray becoming lighter with depth. The parent material is typically friable silt loam but in many places is stratified loam and sandy loam.

Dusky reddish-brown and dark-colored soft and semihard iron concretions occur throughout the profile and are largest and most numerous in the gray mottled layer. The soil is strongly acid throughout. The organic-matter content is low, but it is somewhat higher than that of the soils of the uplands and terraces, and in wooded areas considerable organic matter from decayed vegetation has accumulated in a thin upper surface layer. In places the profile contains scattered pebbles and an appreciable quantity of sand, especially near stream channels where creeks have overflowed and deposited such materials. In many scattered areas it is fine sandy loam or very fine sandy loam below a depth of about 24 inches.

External drainage is slow. The soil is friable and porous enough to allow good movement of water, penetration of roots, and circulation of air. The water table fluctuates from a few to several feet, causing intermittent poor drainage in the lower part of the profile. The soil retains moisture well. It is subject to the usual flooding by adjacent streams, and local scouring and deposition of new alluvium may take place during the floods. Soils near the West Fork Clarks River Drainage Ditch are overflowed only occasionally and are therefore suited to more kinds of crops than those flooded more often.

The present use of this soil is similar to that of Vicksburg silt loam, except that a slightly smaller proportion is in corn and forest and a slightly larger proportion is in lespedeza or idle open land. Use suitability is not so good for most crops as the Vicksburg soil, but crop and pasture yields are about the same except in wet seasons, when yields are less on this soil. Suggestions for management are also the same as for the Vicksburg soil, but, in addition, this soil would be benefited by artificial drainage, either by tile or open ditches, tile probably being preferable. Very little of the soil has been drained by either method.

Dyer silt loam.—This recent to young soil developed under conditions of poor drainage from local alluvium and colluvium, consisting mainly of loessal material and some Coastal Plain material, is not very important agriculturally. It has an aggregate area of 960 acres and is commonly called "white land" or "buckshot land." The relief is level to gently undulating, with slopes up to about 3 percent. External drainage is slow to good, but internal drainage is poor because of a high intermittent water table.

In mode of occurrence this soil is similar to Briensburg silt loam, but it differs in profile characteristics, natural drainage conditions, and agronomic relations. It is similar to Waverly silt loam in profile characteristics but differs in occupying gently sloping areas at the base of hills, gently sloping alluvial fans of small streams entering flood plains of larger creeks, or narrow bottoms along intermittent drainageways in uplands. The areas are not subject to the usual

flooding, though some of them may be covered by water after exceptionally heavy rains. Many areas are made poorly drained by water from springs or seepage emerging at or near the base of the adjacent hills.

When artificially drained this soil is better suited to a wider variety of crops than is Waverly silt loam, but in its naturally poorly drained condition its use is limited. The swampy or permanently wet areas may be used best for permanent pasture. Probably 17 percent of the total area is in forest, 29 percent is used for corn, 7 percent for lespedeza, 5 percent for redtop, 2 percent each for strawberries, soybeans (including cowpeas), and wheat, 1 percent for tobacco, and 35 percent is idle open land. Most of the crops are less well suited to this soil than to Briensburg silt loam. Sorghum cane, lespedeza, redtop, strawberries, soybeans, and cowpeas do fairly well, but cotton, tobacco, alfalfa, red clover, and fruit trees are poorly adapted. Where no lime or fertilizer is applied, corn yields about 25 bushels an acre; lespedeza hay, 1 ton; redtop hay, 1 ton; strawberries, 60 crates; and wheat, 9 bushels.

Establishing sufficient drainage is the first problem to be overcome in the management of this soil. This can be done by the use of either tile drains or open ditches. When the soil has been adequately drained, it is important that lime, organic matter, phosphate, and possibly potash be added and that crop rotations including a leguminous crop be used.

Egam silty clay loam.—This young soil on the flood plains of the Tennessee River has been formed under fairly good drainage conditions from alluvium deposited principally by that river. It covers a total area of 1,600 acres and generally occurs farther from the banks of the Tennessee River than the Huntington soils, occupies lower positions, and becomes inundated sooner by floods, which leave sediments on the soil. Although it is on the flood plain, there are many ridges, swales, or other local undulations that have a gradient of as much as 10 percent. It differs chiefly from Huntington silt loam in having a heavy-textured, more compact, tougher, and medium to strongly acid subsoil.

The surface soil is brown silty clay loam or coarse-textured silty clay loam that is somewhat plastic when wet. It grades at a depth of 7 to 10 inches into a brown heavy-textured silty clay loam or silty clay subsoil that is somewhat compact, tough, and moderately plastic when wet. At a depth of 20 to 30 inches this grades into light-brown, brown, or yellowish-brown moderately to slightly compact and moderately tough silty clay or clay that is fairly plastic and sticky when wet. Below a depth of about 50 inches the subsoil gives way to somewhat coarser textured and less compact and tough material. Mica flakes are mixed through the profile, and small, soft to hard, dark-colored iron concretions also are throughout the profile but are most numerous in the lower subsoil. The surface soil is slightly acid, the upper subsoil medium acid, and the lower subsoil strongly acid, though the acidity varies to some extent from place to place. The content of organic matter is moderate.

In many places the subsoil is stratified, and a somewhat darker colored layer is present. The soil in many areas, especially in the higher lying areas and those nearer the river, is heavy-textured silt



A, Soybeans on Calloway silt loam in foreground and on Grenada silt loam, level phase, near the house. This farmstead near Buensburg is fairly representative of the smoother uplands.

B, Corn on Egam silty clay loam near Eggnier Bridge. The idle land on the right and left is Melvin silty clay loam.



A, Lespedeza stubble mostly on Grenada silt loam southwest of Benton
B, Dark fire-cured tobacco growing on Grenada silt loam, level phase.

loam or heavy-textured loam. In places some gray mottling appears below a depth of about 36 inches.

This soil has poor tilth qualities, and it requires more power for cultivation than does Huntington silt loam. If plowed when too wet it puddles, or runs together, and when dry becomes hard and cloddy; if cultivated when too dry it plows hard and breaks up into clods. It cracks considerably when dry. The lighter textured soil has better tilth qualities and is slightly more productive than the typical soil.

Although this soil has a large water-holding capacity, the water available to crops is less than in Huntington silt loam. The crops begin to suffer rather early during droughts, and in extreme drought the corn crop almost wholly fails.

Probably 12 percent of this soil remains in forest; about 61 percent is used for corn (pl. 3, *B*), 3 percent for soybeans and cowpeas, 2 percent for oats for hay, 1 percent each for lespedeza and redtop, 1 percent for farmsteads, and about 19 percent is idle open land. Owing largely to its heavier texture, more compact and tough subsoil, poorer tilth conditions, and less favorable moisture relations for crops, this soil is not nearly so productive as the Huntington soils. With very little or no fertilizer corn yields about 25 bushels an acre, though in seasons having ample and well-distributed rainfall the yields may be as high as on the Huntington soils. Lespedeza, soybeans, and cowpeas do fairly well; oats grow well and are sown in spring for hay; tobacco, cotton, wheat, and strawberries and alfalfa, sweetclover, and other deep-rooted legumes are not adapted to this soil.

In many places the seedbed is poorly prepared. Plowing at the proper moisture content and the use of stronger work animals or of tractors would aid in securing better seedbeds, better germination of seeds, and better early growth of crops. A crop rotation that includes a legume and the plowing under of a green-manure crop, preferably a legume, would aid in improving the tilth and other physical properties as well as productivity of this soil. It is advisable to apply a small quantity of lime for growing sweetclover.

Gravel pit.—This miscellaneous land type was formed by excavation chiefly in Coastal Plain gravel deposits but also in some areas in chert beds formed by weathering of very cherty limestone. The material obtained from these pits is used largely for road building and to a small extent as aggregate material in concrete construction. The pits range in size from a fraction of an acre to several acres, covering an aggregate area of 64 acres. They are chiefly in the more deeply dissected parts of the county underlain by gravel and chert.

Grenada silt loam.—Although this is an imperfectly drained claypan soil formed from loessal material on the smooth uplands, it is the most important agricultural soil in the county. It has fairly good workability, is fairly well suited to the production of dark fire-cured tobacco, responds well to good management, and although of only average fertility it, together with its level phase, supports the most prosperous agriculture in the county. It is also the most extensive soil, covering a total area of 26,752 acres, mainly on the broad smoother uplands, where very little dissection of the original plain has taken place. Large areas are in the southwestern parts and in the vicinity of Sharpe, Palma, and Briensburg. The relief is gently undulating (2- to 5-percent slope), and external drainage is good.

Under virgin conditions this soil has an upper layer ($\frac{1}{2}$ to 1 inch thick) of dark grayish-brown mellow silt loam, containing considerable organic matter. This layer overlies grayish-brown mellow smooth silt loam about 3 inches thick, which is underlain by light-brown mellow smooth silt loam to a depth of 7 or 8 inches. To a depth of about 22 inches the subsoil is bright yellowish-brown, fading with depth to pale yellowish-brown friable silt loam, which is underlain by mottled yellow-and-gray friable light-textured silty clay loam. The claypan layer begins abruptly at a depth of about 26 inches and consists of medium-gray mottled with yellow and brown very or moderately compact plastic silty clay or silty clay loam. Below a depth of about 40 inches the subsoil is pale-yellow mottled with gray slightly compact but friable light-textured silty clay loam. Reddish or yellowish gravelly, sandy, or sandy clay Coastal Plain material lies at a depth of 4 to 10 feet. Depth to this material is greatest in the western part of the county and least toward the eastern part.

Dusky reddish-brown and dark-colored soft to semihard iron concretions are throughout the soil; if these are semihard or hard pellets they are commonly known as "buckshot." Tilth conditions are good except where impaired by accelerated erosion. The surface soil and subsoil are free from stone and grit. The soil is strongly to very strongly acid to a depth of 6 to 8 feet, where it generally becomes slightly acid.

In cultivated areas where erosion has been negligible, the surface soil to plow depth consists of grayish-brown or light grayish-brown silt loam, becoming grayer when dry. The upper part of the profile does not hinder good percolation of water, but the compact lower subsoil is slowly to very slowly permeable. When the soil above the compact layer is nearly saturated after periods of heavy rainfall, the lower subsoil layer is often dry below a few inches from its top. In vertical cuts along roadsides during wet seasons water is often seen issuing from the subsoil just above the compact layer (pl. 2, *B*). During wet seasons the slow internal drainage impedes the storing of water in the soil, thereby causing greater runoff, and the reduced supply of water causes crops to suffer more during drought than on soils having a greater reserve of available moisture. Roots readily penetrate the friable upper subsoil, but few enter the compact lower subsoil and those that do generally follow vertical cracks.

When not protected by vegetative cover or other means, this soil is subject to harmful sheet erosion and slight gully erosion. Several factors combine to make this a moderately erodible soil. The surface runoff is increased by slow internal drainage caused by the compact subsoil layer. Poor granulation in the surface soil is brought about by the low content of organic matter and lime. This deficiency decreases the absorption of water and, together with the uniformly fine texture, causes the soil particles to be easily washed away. As the surface soil is gradually washed away, these conditions worsen and erosion rapidly increases. Such erosion is more damaging on this soil than on those of the Loring and Memphis series, as it brings the claypan nearer the surface.

The degree of erosion that has taken place is associated directly with the slope and the management of the soil during its cropping history, and the extent is shown on the soil map by symbols. About 20 percent

of the soil has lost one-third to two-thirds of its surface layer by accelerated erosion, and 10 percent, more than two-thirds; about 1 percent is gullied.

About 7 percent of this soil is in forest, 42 percent is idle open land, 17 percent is used for corn, 9 percent for lespedeza (pl. 4, *A*), 6 percent for wheat, 4 percent for redtop and timothy, 3 percent for tobacco, 2 percent for strawberries, 2 percent for soybeans and cowpeas, 1 percent for cotton, and the rest for farmsteads and minor crops.

This soil is naturally only fairly well suited to corn, but it responds well to good management. Under the usual farm practices corn yields about 24 bushels an acre, but after lime, phosphate, and some manure have been applied and a rotation including a legume is used, corn averages about 35 bushels, and yields of 45 bushels are often obtained (17).

Dark fire-cured tobacco is well suited to this soil and is of good grade if properly grown and cured. Tobacco usually follows lespedeza or redtop and is nearly always fertilized and generally manured. Most growers apply about 100 pounds an acre of a complete fertilizer and obtain yields averaging about 800 pounds an acre. Superphosphate alone or in combination with manure is sometimes applied. After applying manure and 200 to 400 pounds an acre of a complete fertilizer, many of the more successful growers obtain yields of 1,000 to 1,200 pounds an acre.

Strawberries do fairly well on this soil, especially after organic matter and phosphate have been added. Approximately half the total acreage of strawberries is fertilized, usually with 100 pounds of 20-percent superphosphate an acre. Acre yields average about 70 crates of 24 quarts each with fertilization and about 60 crates without it. Wheat yields average about 10 bushels an acre without lime or phosphate and about 13 bushels where these amendments have been applied and where a rotation containing a legume is used. Cotton is not well suited to this soil, chiefly because of impaired drainage and consequent late maturity. Cotton yields of 200 pounds an acre under common management probably would be considerably improved by the application of a complete fertilizer.

Lespedeza is well suited to this soil and yields about 0.7 ton of hay an acre without the use of lime or phosphate and about 1.3 tons with these amendments. Redtop does fairly well, yielding about 0.6 ton of hay an acre, but red clover, sweetclover, and alfalfa generally fail unless lime has been applied. This soil is not well suited to alfalfa and fruit trees because of its compact and slowly permeable subsoil.

The first step in good management of this soil is to correct the acidity by applying about 2 tons of ground limestone an acre. It is also important that rotations including legumes and grasses be used and that winter cover crops follow all clean-cultivated crops. Organic matter should be added by the return of manure and crop residues, and phosphate fertilizer should be applied. Terraces or other erosion-checking devices need to be used where conditions and crop requirements warrant (1).

Grenada silt loam, level phase.—Agriculturally, this is the second most important soil on the uplands—chiefly because of its relatively large extent and its favorable nature for the production of good-quality dark fire-cured tobacco (pl. 4, *B*). This phase is similar to

the normal phase of the type but differs chiefly in that it occurs on level to nearly level relief, the steepest slopes being about 2 percent, and in that the surface soil in cultivated fields is slightly deeper, the yellowish-brown layer just below the surface soil is less bright in color and thinner, and the compact lower subsoil layer is heavier and more compact and dense. External drainage is slow to good and internal drainage moderately slow to slow. A total of 7,616 acres is mapped, fairly large areas being in the southwestern part of the county and in the vicinity of Sharpe, Palma, and Briensburg, where the original plain has been but little dissected.

To a depth of about 8 inches the surface layer is grayish-brown or light grayish-brown mellow silt loam. Below this is yellowish-brown or brownish-yellow friable silt loam that grades at a depth of about 22 inches into mottled yellow-and-gray friable heavy-textured silt loam. The claypan (siltpan or hard layer), consisting of mottled-gray with yellow and brown compact plastic silty clay loam about 12 inches thick, lies below a depth of about 26 inches and is underlain by pale yellowish-brown slightly compact but friable light-textured silty clay loam or silt loam. Reddish- or yellowish-colored gravelly, sandy, or sandy clay Coastal Plain material lies at a depth of 4 to 10 feet. The soil is permeable to both moisture and roots down to the claypan, or siltpan, which is slowly or very slowly permeable. The soil is strongly to very strongly acid to a depth of 6 to 8 feet, where it generally is slightly acid.

This soil is used in much the same way as the normal phase, but less of it is in idle open land because erosion is more easily controlled. Perhaps 23 percent is idle open land, 9 percent in forest, 23 percent in corn (pl. 5, *A*), 12 percent in lespedeza, 7 percent in redtop, 7 percent in wheat, 5 percent in tobacco (pl. 5, *B*), 5 percent in soybeans and cowpeas, 2 percent in strawberries, and the rest in farmsteads and minor crops.

When properly managed this is a productive soil for many of the crops commonly grown in the area. It is easily worked and easily conserved against losses by runoff. Yields of most crops average 10 to 15 percent higher than on the normal phase, and suggestions for management are similar to those for that soil, except that terraces and other engineering measures are not necessary for erosion control.

Henry silt loam.—This soil of the uplands, developed under very poor drainage from loessal material, is commonly called "white land," or "glade land." It occurs in the vicinity of Enterprise, Van Zora, and Jackson Schools and Rose Crossroads, covering a total of only 128 acres. The relief is level or nearly level, the slope being less than 1 percent. External drainage is poor, though small drainageways in many of the areas afford better external drainage.

In cultivated fields the surface soil to a depth of 5 or 6 inches is light-gray mellow silt loam containing small mottlings of light brownish gray, pale yellow, and rusty brown; when dry, it is very light gray. In wooded areas the first inch or two of the surface soil is medium gray in many places, though the accumulation of organic matter is seldom enough to produce a dark-colored layer. The 4- to 6-inch lighter colored mellow silt loam subsurface layer has fewer mottlings and is underlain by about 2 inches of whitish-gray or ashy-colored floury silt loam having very few or no mottlings. The sub-



- A*, Corn on Grenada silt loam, level phase, near Palma. The corn grown in this field is followed by wheat.
- B*, Farmstead on the smoother uplands near Palma. The field in the foreground is Grenada silt loam, level phase, on which tobacco has been grown. Grass and legumes are on the tobacco land. The tobacco barn is the new type with roof and floor ventilators.



A, Corn on Lindside and Egam silty clay loams, near Eggner Bridge. Wooded area in the left background is on Melvin silty clay loam. Corn in the right background is on Huntington fine sandy loam.

B, The cleared land is Tigrett cherty loam about 1½ miles southwest of Eggner Bridge. Chert fragments are characteristic of this soil and many are scattered over the ground. Wooded background is on Bodine cherty loam. The building on the right is an old-type tobacco barn without ventilators. This farmstead is fairly representative of those in the hilly eastern part of the county.

soil, beginning abruptly at a depth of 11 to 14 inches, is medium-to light-gray, mottled with pale yellow and grayish brown, very compact and dense silty clay that is very plastic and sticky when wet and hard or tough when dry. It breaks fairly easily into medium-sized subangular aggregates that are hard when dry. A whitish-gray coating of silty material on the aggregates in the upper part of the subsoil decreases with depth. Below a depth of about 35 inches the subsoil is light-gray moderately compact and dense silty clay loam containing some yellow and rusty-brown colors; below a depth of about 50 inches it is lighter textured and somewhat less compact. Gravelly, sandy, or clayey Coastal Plain material is reached at a depth of about 60 to 96 inches.

Dusky reddish-brown and dark-colored small soft to semihard iron concretions are throughout the profile in most places, generally being most numerous in the surface and subsurface layers, but they are nowhere so numerous or so large as in Calloway silt loam. The entire profile is very strongly acid.

The compact and dense subsoil is very slowly permeable to water. Because of the shallow depth to the subsoil, the permeable layers above it are soon saturated in wet seasons, and water often stands on the surface for considerable periods. This condition causes poor circulation of air within the soil, and beneficial bacterial action and other factors favorable to good crop production are greatly retarded or prevented. Roots are largely restricted to the upper layers of the profile, as the subsoil is also very slowly pervious to them; consequently, reductions of the feeding zone of most crops cause serious injury during protracted dry weather.

Because of the foregoing unfavorable features this soil is poorly suited to the crops grown, and its value for cropland is decidedly low. Probably 50 percent of it is in forest; 10 percent is used for corn, 8 percent for lespedeza, 5 percent for redtop, 3 percent for soybeans and cowpeas, 2 percent for sorghum cane, 1 percent each for strawberries and tobacco, and 20 percent is idle open land. Under common management corn yields about 12 bushels an acre; strawberries, 30 crates; and lespedeza, 0.6 ton of hay. With some artificial drainage, liming, proper fertilization, and other good soil management, corn yields about 20 bushels an acre; strawberries, 60 crates; and lespedeza, 1 ton of hay. Under common management tobacco yields about 650 pounds an acre, but the grade is only fair, as the leaf generally is thin. This soil is best suited to sorghum cane from which molasses of high quality is produced. Strawberries, redtop, lespedeza, soybeans, and cowpeas do fairly well, but cotton, small grains, alfalfa, red clover, and fruit trees are not adapted to this soil.

Areas in forest probably should remain so. Artificial drainage is one of the most important measures in the management of the cleared soil. Practically no attempt has been made to drain the land, but drainage can be obtained best by the use of open ditches and bedding or closely spaced dead furrows. Other important management practices include heavy liming, the addition of organic matter in the form of manure, green manure, and crop residues, the application of phosphate and potash fertilizers, and the use of crop rotations that include legumes.

Huntington silt loam.—Covering a total of 896 acres, this recent soil generally occupies positions on natural levees adjacent to or near the Tennessee River, where it lies somewhat higher than the bottom land farther from the river and is not inundated so soon but is covered by most floods. Most of the sloping river banks are included with the soil as mapped. This soil has formed under good drainage conditions from alluvium, the material of which came largely from uplands of the Tennessee River drainage basin underlain by limestone and to a lesser extent from sandy, loessal, and other materials. It often receives sediments deposited during inundations. Although it is on the flood plain, its surface has local undulations of as much as 10 percent.

The upper part of the soil profile to a depth of 10 to 12 inches consists of brown friable silt loam. Below this the profile is similar, except that it generally is slightly lighter colored and slightly heavier textured. In many places it is stratified, and in some places it contains a somewhat darker colored layer. The material is friable and easily penetrated by roots and water; a good supply of moisture is generally available for plants.

Mica flakes are numerous throughout the profile, and a few small iron concretions are in the lower part in places. The soil contains a moderate quantity of organic matter. It is the least acid soil in the county, being slightly acid to neutral, though in places it is medium acid below the top layer. In many places the texture of the upper layer is loam, and in places the lower material is heavier textured than is common.

About 20 percent of this soil is in forest, 64 percent is used for corn, 3 percent for soybeans and cowpeas, 2 percent for oats and hay, 1 percent each for lespedeza and redtop, and 9 percent is idle open land. It is one of the most fertile soils in the county and the most productive for corn. The average yield of corn is about 40 bushels an acre without the use of lime, fertilizer, or manure, and on many farms corn is grown continuously on the same land for many years. Without fertilizer soybeans yield about 2 tons of hay an acre. Lespedeza and grass do well when not damaged by flood, and oats for hay also do well. Cotton makes a rank growth, and the bolls mature slowly. The tobacco produced is of low grade. Probability of floods makes the growing of perennials and fall-sown crops risky.

Crop yields may be improved by a suitable crop rotation that includes a legume and by the addition of organic matter from crop residue and green manure. A light application of lime is advisable when sweetclover is grown.

Huntington fine sandy loam.—This slightly acid to neutral soil, having an aggregate area of only 256 acres, is similar to Huntington silt loam in the character of parent material, method of formation, occurrence, condition of drainage, and likelihood of being flooded but differs principally in having a coarser texture. Its upper layer is brown mellow fine sandy loam. Beneath this the profile has practically the same texture but is light brown to yellowish brown in places. In many places it is stratified, and its texture varies considerably but generally is sandy. Many mica flakes are in the profile.

The use, suitability for crops, and suggestions for management of this soil are similar to those for Huntington silt loam. Although this soil is productive, the crop yields average about 5 percent less than on

that soil, the water-holding capacity is somewhat less, and the moisture relations are slightly less favorable to plant growth.

Mapped with this soil are small areas in which the soil is loamy fine sand or sandy loam.

Hymon loam.—This recent soil lies on nearly level flood plains of creeks and smaller rivers, where it has been formed under fair drainage conditions from alluvium composed of Coastal Plain and loessal materials. It is similar to the Shannon and Beechy soils in character of parent material but intermediate in other profile characteristics, drainage conditions, and agronomic relations. It is similar to Collins silt loam in drainage conditions, agronomic relations, and profile characteristics except texture and parent material. It is one of the most important soils of the bottom lands and covers a total of 7,168 acres, generally some distance from creek and river channels and mainly near areas of Brandon, Lexington, and Providence soils.

The surface soil is light-brown or slightly grayish-brown mellow loam, and it passes at a depth of about 7 inches into light-brown or slightly yellowish-brown friable loam. Below a depth of 10 to 30 inches the subsoil is mottled-gray, yellow, grayish-brown, and rusty-brown friable loam.

Soft and semihard dusky reddish-brown and dark-colored iron concretions are throughout the soil but are largest and most numerous in the gray mottled part. Some small mica flakes are in the soil in some areas. Below the surface soil in many places the profile is composed of stratified light-textured material ranging from loam to gravelly sand. In places pebbles occur in varying quantities throughout the profile and, where numerous on the surface, they are indicated on the map by gravel symbols. The texture of the surface soil varies from place to place in some areas, being silt loam, fine sandy loam, loamy sand, or gravelly loam. The organic-matter content is low; the reaction is strongly acid; and tilth conditions are excellent.

The use suitability for crops and suggestions for management of this soil are practically the same as for Vicksburg silt loam, but the crop yields average about 5 percent less. Lower yields than common for this soil are obtained on the areas containing rather large quantities of pebbles.

Iola gravelly loam.—Low fertility, tendency to dry out readily, and small extent make this gravelly soil of little importance for agriculture. Its gravelly texture hinders cultivation to some extent. The relief is level to rolling, with slopes up to about 15 percent. Drainage is excessive, and crops are easily injured by droughts, but there is very little or no erosion. The soil covers a total of only 256 acres on long, narrow ridges on terraces of the Tennessee and East Fork Clarks Rivers. These ridges generally are parallel with the stream valley, and in many places they join at one end with the uplands and in some places form the boundary between the terrace and first bottom. They may rise 5 feet or somewhat more above the terrace level and 20 feet or more above the adjacent bottom land.

The 6- to 8-inch surface soil is light-brown to moderate-brown loose gravelly loam. It is underlain by light-brown to yellowish-brown fairly loose gravelly loam that grades below a depth of about 15 inches into yellowish-brown to light-brown loose gravel that may continue

to a depth of 20 feet or more. The pebbles are 2 inches or less in diameter, well rounded, and consist of chert and some quartzite. The profile is slightly to medium acid.

About 31 percent of this soil is in forest; 10 percent is used for corn, 6 percent for cotton, 5 percent for lespedeza and redtop, 3 percent for strawberries, 2 percent for wheat, 8 percent for farmsteads and vegetables; 25 percent is idle open land, and 10 percent is gravel pits. Most crops are not well suited to this soil because of its large gravel content, very low water-holding capacity, and low natural fertility. Early vegetable crops and fall-sown small grains and other winter crops that mature early in summer are better suited to it, and cotton does fairly well. Corn and other summer crops yield fairly well when rainfall is sufficient. Under usual farming practices corn yields about 12 bushels; wheat, 5 bushels; strawberries, 30 crates; and cotton, 120 pounds an acre.

In the management of this soil it is important that farmyard manure, green manure, and crop residues be added to supply organic matter and increase the water-holding capacity. A light application of lime would aid the growth of legumes. Applications of fertilizers are advisable for most crops.

Lexington silt loam.—Formed on uplands under good drainage conditions from a shallow covering of loessal material over Coastal Plain stratified sand, sandy clay, or other sandy material, this soil differs from Memphis silt loam mainly in having considerable sandy material above a depth of about 42 inches. A total of 960 acres is distributed over the rougher uplands, principally in southeastern parts and near Oak Level. The relief is strongly rolling and hilly, the slopes ranging from 10 to 18 percent. External drainage is free.

Under virgin conditions the surface soil to a depth of $\frac{1}{2}$ to 1 inch is dark grayish-brown silt loam containing considerable organic matter derived from oak and hickory leaves and twigs. This layer is underlain to a depth of about 6 inches by light grayish-brown smooth mellow silt loam. After cultivation the plowed layer is light grayish brown and becomes more gray when dry. The surface soil overlies yellowish-brown friable silt loam to a depth of 9 to 12 inches. This layer grades into a bright yellowish-brown, tinged with brown or reddish-brown, slightly compact but somewhat friable silty clay loam or clay loam subsoil that breaks down into firm subangular particles and contains varying quantities of sand grains, especially in the lower part. Below a depth of 25 to 32 inches the subsoil is lighter textured, contains more sand grains, and is more friable. It allows good movement of air and water and good penetration of roots. Some gray is in this layer, especially in cracks and root channels, and a few small dusky reddish-brown and dark-colored soft and semihard iron concretions occur in places. With increase in depth the subsoil grades into reddish-brown or reddish-yellow stratified Coastal Plain sand or sandy material, mixed in some places with pebbles.

The soil is medium to strongly acid. In places some mica is in the Coastal Plain material, and in many places ferruginous or iron-cemented sandstone rocks are on or in the soil. Owing to differences in the thickness of the silty loessal covering, the depth to the sandy part of the subsoil and the quantity of sand grains present vary considerably.

The degree and condition of erosion are about the same on this soil as on Brandon silt loam, except the gullies are much larger because of undercutting and caving in at their sources. Strong slopes make the use of heavy farm machinery difficult. The soil allows good movement of air and water and good penetration of roots.

Except for a somewhat greater acreage in strawberries, cotton, and corn and a correspondingly smaller acreage in idle open land, this soil is used for the same purposes as Brandon silt loam. Its suitability for crops is similar to that soil, and management requirements are the same, but productivity is slightly higher.

Lexington silt loam, undulating phase.—Owing to difference in relief this soil differs from the normal phase of the type in drainage, erosion, and depth of surface soil, but it is similar in color, texture, consistence, structure, and parent material. The relief is gently undulating, external and internal drainage are good, and the water-holding capacity is fairly good.

The surface soil is usually slightly deeper and the underlying sandy Coastal Plain material generally lies at a greater depth than in the normal phase. When not protected the soil is subject to harmful sheet erosion and some gully erosion. The erosion condition is similar to that of Grenada silt loam, and eroded areas are shown on the map by symbols. An aggregate area of 768 acres of the soil is mapped on the top of narrow ridges in the hilly southeastern part of the county.

The suitability for crops and present use of this phase are practically the same as for Memphis silt loam. About 12 percent is in forest; 8 percent is used for corn, 3 percent for cotton, 3 percent for tobacco, and 11 percent for other crops; 63 percent is idle open land. Under common management corn yields about 25 bushels an acre; tobacco, 725 pounds; wheat, 13 bushels; and cotton, 260 pounds. Red clover does not grow so well as on Memphis silt loam, and all crops are injured slightly more by droughts. This phase responds well to good management, however, and suggested management practices are the same as for Grenada silt loam.

Lexington silt loam, rolling phase.—This soil is similar in physical characteristics and parent material to the normal phase of the type, but it differs in occupying less strongly rolling relief and consequently in drainage and erosion conditions and depth of surface soil. External drainage is good to free, and internal drainage good. In general the surface soil is slightly deeper, and the depth to the underlying sandy Coastal Plain material is greater. When poorly managed this phase is subject to severe sheet and gully erosion, but it has been less eroded than Loring silt loam, rolling phase. The eroded areas are indicated on the soil map by symbols. A total of 512 acres of this soil is mapped in the hilly southeastern part of the county, and individual areas are relatively small.

About 21 percent of this soil is in forest; 5 percent is used for corn, 6 percent for lespedeza, 3 percent for farmsteads, 2 percent for wheat, 2 percent for cotton, and 1 percent for tobacco; 60 percent is idle open land. The use suitability, crops grown, and suggested management are similar to those for Memphis silt loam, though crop yields probably average slightly less.

Mapped with this soil is a total of about a third of a square mile having loam surface soil and a more sandy subsoil.

Lexington loam.—This soil is similar to Lexington silt loam in the character of parent material, mode of occurrence, relief, drainage, erosion condition, reaction, and the principal profile characteristics except texture. It is, however, developed from a thinner covering of loessal material, and the sandy Coastal Plain material is nearer the surface, producing a somewhat lighter texture in the surface soil and subsoil. It covers a total of 1,088 acres, mostly on rougher uplands east of Hardin.

The surface soil consists of light grayish-brown mellow loam, and the subsoil is fairly friable clay loam, which is slightly plastic and sticky when wet. The subsoil varies in color from bright yellowish brown of reddish tinge to reddish brown and in many places is more reddish brown than the subsoil of Lexington silt loam.

Owing to the higher proportion of sand in the surface soil and subsoil, this soil absorbs water slightly faster than does Lexington silt loam and consequently is somewhat less eroded. Its inherent fertility, however, is slightly lower. The present use suitability for crops and suggestions for management of this soil are similar to those for Brandon silt loam, but crop yields are a little higher.

A few areas of fine sandy loam are included with this soil as mapped.

Lexington loam, steep phase.—Because of steepness this phase is excessively drained externally, absorbs less water, and dries out faster than the normal phase of the type; otherwise it is similar to that soil in profile characteristics and most other respects. Relief is hilly and steep, with slopes of 18 percent and more, though in most places less than 40 percent, and internal drainage is good. The soil is more subject to harmful erosion than the normal phase and has lost 4 inches or somewhat more of its original surface soil by accelerated erosion caused by the usual field operations. Gully erosion is common, and the gullies are very large in many places as a result of undercutting and caving in at their sources. This phase occupies a total area of 2,176 acres, mostly in southwestern parts and in the vicinity of Oak Level.

In general the surface soil is slightly shallower than that of the normal phase, and both the surface soil and subsoil are somewhat lighter textured. Considerable variation exists in the color, texture, and consistence of the subsoil.

The present use of this phase and the suitability for crops are similar to those for Brandon silt loam, steep phase, although crop yields are about a third lower. Heavy farm machinery cannot be used satisfactorily. Because of its strong slope and other unfavorable features this phase apparently may be used most feasibly for forest.

Mapped with this phase are some areas having a silt loam texture, which would have been mapped as Lexington silt loam, steep phase, had they been more uniform and more extensive. These areas are more common on slopes facing north and east.

Lindside silt loam.—Under fair drainage conditions this recent soil has formed on the Tennessee River flood plains from deposits of alluvium. It is derived from the same kind of parent material as Huntington and Melvin silt loams but is intermediate between those soils in profile characteristics, drainage conditions, and agronomic relations. External drainage is slow and internal drainage moderately slow to slow because of a fairly high intermittent water table. This

soil covers a total area of 704 acres, occupying a lower position than the Huntington and Egam soils but higher than the Melvin soils. Many of the areas are on first bottoms of small streams flowing across the terraces of the Tennessee River and probably contain more loessal and Coastal Plain materials than do areas on the main flood plains of the river. The loessal and Coastal Plain materials of areas along the small streams were washed from nearby hills.

The surface soil is brown friable silt loam underlain at a depth of about 7 inches by material of similar texture but slightly lighter color. At a depth of 10 to 30 inches this material grades into gray friable silt loam or light-textured clay loam, mottled with grayish brown, rusty brown, and yellow, the gray becoming lighter with depth. Beneath the surface soil the profile is stratified in many places and generally consists of medium-textured material.

Soft to hard dusky reddish-brown and dark-colored iron concretions are throughout the soil but are largest and most numerous in the gray mottled part. The surface soil is medium to slightly acid, and the rest of the profile is strongly to medium acid, though the acidity varies considerably in different areas. The surface soil contains a moderate quantity of organic matter. If the water table were lowered by artificial drainage the subsoil would drain well. The soil is inundated by most floods of the river, and sediments are often deposited during inundation. During drought it holds a good supply of moisture available to plants. Tilth conditions are good.

About 41 percent of this soil is in forest, 36 percent is used for corn, 2 percent for soybeans and cowpeas, and 21 percent is idle open land. A proportionately greater acreage of the soil on first bottoms of small streams crossing the Tennessee River terraces is in forest, and a proportionately smaller acreage is in corn than of the soil on the main flood plains of the river. Crops that may be grown are practically the same as for Huntington silt loam, but the soil is less well suited to most of them mainly because of its poorer drainage. Corn yields about 34 bushels an acre without fertilization. Yields of other crops are about 15 percent less than on Huntington silt loam.

A suitable crop rotation including a legume should be followed on this soil, and green manures or crop residues should be added to supply organic matter. Liming is advisable for growing sweetclover. Artificial drainage similar to that suggested for Collins silt loam would benefit this soil.

Lindside silty clay loam.—This soil is similar to Lindside silt loam in most respects, except texture, and to Egam and Melvin silty clay loams in character of parent material but intermediate between them in other profile features, drainage conditions, and agronomic relations. It has a total extent of 448 acres and occupies a lower position on the main flood plains of the Tennessee River than the Egam soil but higher than the Melvin soils. External and internal drainage and susceptibility to flooding are the same as on Lindside silt loam, but crops on it do not withstand drought so well. Tilth conditions are not good, being similar to those of Egam silty clay loam.

The surface soil is brown or slightly grayish-brown silty clay loam. At a depth of 10 to 30 inches this grades into gray or bluish-gray silty clay or silty clay loam, mottled with grayish brown, rusty brown, and

yellow, somewhat friable but plastic when wet. This layer becomes lighter colored with depth. Other profile characteristics are similar to those of Linside silt loam.

The present use, suitability for crops, crop yields, and suggestions for use and management of this soil are the same as for Egam silty clay loam (pl. 6, A). In addition artificial drainage would be beneficial.

Loring silt loam.—This fairly well drained soil, developed on uplands from loessal material, is intermediate in profile characteristics, internal drainage, and agronomic relations between Grenada and Memphis silt loams. The aggregate area of 8,256 acres is mapped generally on relatively narrow ridge tops in the rougher and more dissected parts of the county, whereas Grenada silt loam typically is on broad interstream divides where dissection is slight and Memphis silt loam generally is on very narrow ridge tops in the roughest and most dissected parts. The relief is gently undulating (2- to 5-percent slope); external drainage is good and internal drainage fairly good.

The 7- or 8-inch surface soil is grayish-brown mellow silt loam. It overlies bright yellowish-brown friable light-textured silty clay loam or heavy-textured silt loam, which breaks into small soft to firm rounded to subangular nutlike aggregates having a brown tinge on the outside. The subsoil below a depth of 20 to 27 inches is pale yellowish-brown friable light-textured silty clay loam, somewhat mottled with gray and rusty brown. This layer, below a depth of 27 to 35 inches, overlies dull yellowish-brown moderately compact silty clay loam, mottled with gray, rusty brown, and yellow, that breaks into medium-sized firm to hard subangular nutlike aggregates. At a depth of 37 to 48 inches this layer overlies light-brown or yellowish-brown heavy-textured silt loam or light-textured silty clay loam, which is slightly compact but rather friable and in places contains a few mottlings of gray and rusty brown. Reddish- or yellowish-colored gravelly, sandy, or sandy clay Coastal Plain material lies at a depth of 4 to 9 feet, the depth generally being greater in the western part of the county and less in the eastern part.

Some dusky reddish-brown and dark-colored soft to semihard small iron concretions are throughout the soil, being somewhat more numerous in the gray mottled lower subsoil. The surface soil and subsoil are practically free from stones, gravel, and sand. The lower subsoil is moderately to slowly permeable and, though it probably restricts the movement of water through the soil to some extent, is permeable to roots. The soil is strongly acid, except a thin dark-colored upper layer in forested areas and the material below a depth of 5 or 6 feet, which are generally medium to slightly acid.

In places where this soil has been considerably eroded, the surface soil to plow depth is yellowish brown. The soil profile varies somewhat in thickness, compactness, and intensity of the gray in the mottled lower subsoil.

This productive soil is easily worked, but it is subject to erosion when not protected by a good vegetative cover. It is not so erosive as Grenada silt loam, however, because of its more permeable subsoil. Perhaps about 20 percent of it has lost one-third to two-thirds of its surface layer by erosion, about 10 percent has lost more than two-

thirds, and less than 1 percent has been gullied. Eroded areas are indicated by appropriate symbols on the soil map.

Probably 7 percent of the total area of this soil remains in forest, 10 percent is used for corn, 8 percent for lespedeza and redtop, 6 percent for wheat, 5 percent for strawberries, 4 percent for tobacco, 3 percent for cotton, and 2 percent for soybeans and cowpeas, about 7 percent is in farmsteads, and 48 percent is idle open land. Most crops grown are slightly better suited to this soil than to Grenada silt loam, the principal exception being dark fire-cured tobacco that is generally of somewhat inferior grade. Alfalfa, sweetclover, other deep-rooted crops, and fruit trees do better, as the subsoil is more permeable and better aerated than in the Grenada soil.

Management, including liming and fertilizing, of this soil is similar to that of Grenada silt loam. Corn yields about 27 bushels an acre where the usual management is practiced and about 39 bushels where lime, phosphate, and some manure are regularly applied and a suitable crop rotation containing a legume is practiced. Under common management, tobacco yields about 775 pounds an acre. Strawberries yield about 65 crates an acre without the use of fertilizer and about 75 crates with it. Under common management wheat yields about 12 bushels; lespedeza, about 0.8 ton of hay; and cotton, about 240 pounds an acre. After applications of lime and phosphate wheat yields about 15 bushels; lespedeza, 1.4 tons of hay; and cotton, 360 pounds. Applications of potash and nitrogen in addition to phosphate would probably be beneficial to cotton. The suggested management for this soil is the same as for Grenada silt loam.

Loring silt loam, rolling phase.—Covering a total area of 6,656 acres, this soil occurs in relatively small areas scattered over most of the uplands. It is similar in significant profile characteristics and parent material to the normal phase of the type but differs in having a rolling relief (5- to 10-percent slope) and in resultant differences in erosion, moisture conditions, and thickness of surface soil. External drainage is good to free and internal drainage fairly good.

In general this soil has a thinner surface soil than the normal phase, the yellowish-brown subsoil is brighter colored, and the lower subsoil is less compact. The depth to sandy, gravelly, or sandy clay Coastal Plain material is also less, generally $3\frac{1}{2}$ to 6 feet.

Where not protected by a vegetative cover, the soil is subject to severe sheet and gully erosion. Under the usual practices of cultivation one-third to two-thirds of the original 6-inch surface soil has been lost by accelerated erosion. Areas having lost more than two-thirds of the surface soil are indicated by symbols on the soil map. About 20 percent of this phase has lost two-thirds or more of the surface soil by sheet erosion, 10 percent has been moderately gullied, and 3 percent has been severely gullied. Its eroded condition is unfavorable to good crop production. Much of the relatively low contents of original organic matter and nitrogen have been lost. The surface soil is so thin that subsoil material is mixed with it by the plow, causing the soil to become hard and crusty on top in dry weather. This condition reduces the quantity of rain water that soaks into the soil, resulting in greater crop damage from the lack of internal moisture during drought.

About 10 percent of this soil is in forest; 10 percent is used for corn, 11 percent for lespedeza, 7 percent for wheat, 3 percent for redtop, 1 percent for tobacco, 2 percent for other crops, and 4 percent for farmsteads; 52 percent is idle open land. Crop yields average about 30 percent less than on the normal phase. Yields are very low on the severely eroded areas, and during drought there is much crop failure. Most of the severely eroded and gullied areas are idle open land.

This phase is not well suited to clean-cultivated crops, and special precautions must be taken to check erosion when such crops are grown. Terraces or other measures for controlling erosion are necessary, and contour tillage is advisable. It is important that winter cover crops follow all cultivated crops. Other suggestions for the use and management of this phase are the same as for the normal phase.

Mapped with this soil are a few areas having a more compact, dense, and less permeable lower subsoil somewhat resembling the lower subsoil of Grenada silt loam.

Melvin silt loam.—This soil is formed from alluvial material on the flood plains of the Tennessee River under poor natural drainage conditions. External and internal drainage, probability of being flooded, and moisture relations are similar to those of Waverly silt loam. It occupies a total area of 1,600 acres at lower elevations than the Linside soils and is known as "white land," "buckshot land," or "crawfishy land." In some places this soil is in first bottoms of small streams flowing across terraces of the Tennessee River, the areas generally being separated from the terraces by short steep slopes or escarpments and some of them probably containing loessal and Coastal Plain materials washed from nearby hills. A few areas in the main flood plains of the Tennessee River are in low, rather long, narrow swales or sloughs.

The surface soil consists of brownish-gray or mottled-gray, grayish-brown, and rusty-brown friable silt loam. Under virgin conditions there is a very thin topmost layer of darker color caused by an accumulation of organic matter. At a depth of 5 to 10 inches the surface soil is underlain by light-gray friable silt loam, mottled with yellow, rusty brown, and brownish gray, that continues to a depth of 30 inches or more.

The surface soil contains a moderate to low quantity of organic matter and in some places is friable loam. Beneath the surface soil in some places the profile is stratified with material of different textures. Soft to hard dusky reddish-brown and dark-colored iron concretions are numerous throughout the soil, and fine mica flakes are fairly numerous. The soil is strongly to medium acid. A large swampy area of the soil about three-fourths mile west of Gilbertsville originally was peat, which was thoroughly burned a few years ago.

About 70 percent of this soil is in forest, 18 percent is idle open land (including pasture), 10 percent is used for corn, and the rest is used for other crops. Suitability for crops, crop yields, and suggestions for management of this soil are the same as for Waverly silt loam.

Melvin silty clay loam.—In most places this soil is more poorly drained than Melvin silt loam; otherwise, flooding and moisture relations and most physical characteristics, except texture, are the same for both. It covers a total of 1,024 acres, mostly in low, long, narrow

swales, sloughs, or old river channels in the main flood plains of the Tennessee River. Most of the areas are somewhat distant from the river and lie between areas of Egam or Lindside silty clay loams and the steep slopes and escarpments bordering the river terrace. Tilth conditions are not good, being similar to those of Egam silty clay loam.

Below the silty clay loam surface soil the texture of the subsoil varies from silty clay loam to clay. In some of the wetter areas the surface soil is darker colored than in other areas.

About 55 percent of this soil is in forest, 28 percent is idle open land (including pasture), 16 percent is used for corn, and the rest for other crops. As in the case of most of the other poorly drained soils of the bottom lands, the yields obtained depend largely on the kind of season. Corn may yield 35 bushels an acre in a favorable season, but such a season occurs only once in every 3 to 5 years.

This is one of the soils of highest fertility in the county, but owing to poor drainage, flooding, and poor tilth conditions its best use under present conditions is for permanent pasture. If adequately drained it would be fairly productive of corn, soybeans, cowpeas, redtop, oats for hay, and lespedeza, providing other needed management were practiced.

Memphis silt loam.—This well-drained soil of the uplands, formed from loess, differs from Grenada and Loring silt loams in being formed under good drainage conditions and in having no mottled-gray compact layer or claypan. It has a rolling surface, with a slope of 5 to 10 percent. Internal drainage is good, and surface drainage is free where the soil is tilled. The soil occurs in relatively small scattered areas in the northeastern part of the county, covering an aggregate area of 832 acres.

The 7- or 8-inch light grayish-brown mellow silt loam surface soil grades into bright yellowish-brown friable heavy-textured silt loam or light-textured silty clay loam, which at a depth of about 15 inches grades into brown or yellowish-brown slightly compact silty clay loam. This material breaks into firm medium-sized subangular nutlike aggregates. Below a depth of 27 to 33 inches is dull yellowish-brown friable heavy-textured silt loam to light-textured silty clay loam of a structure similar to that of the layer above. This layer is underlain by reddish- or yellowish-colored sandy or gravelly Coastal Plain material at a depth of $3\frac{1}{2}$ to 7 feet or more.

The soil is medium to strongly acid, moderately fertile, and permeable to both water and roots. The erosion hazard on it is greater than on its undulating phase.

This is one of the better crop soils of the uplands. It is fairly productive and, though the surface is rolling, not difficult to work. In a tilled condition it is susceptible to erosion, however, and good management requires that practices be used to check this hazard.

Probably 10 percent of this soil is in forest; about 10 percent is used for corn, 10 percent for lespedeza and redtop, and small proportions for cotton, strawberries, cowpeas, and other miscellaneous crops. More than 40 percent is idle.

Under common management, corn yields about 20 bushels; wheat, 9 bushels; cotton, 180 pounds; strawberries, 48 crates; and lespedeza, 0.6 ton of hay an acre. With proper applications of lime and ferti-

lizer and other good management practices corn yields about 30 bushels; wheat, 12 bushels; cotton, 280 pounds; strawberries, 60 crates; and lespedeza, 1.1 tons of hay. Under common management tobacco yields about 575 pounds, but the grade generally is not good. Alfalfa and sweetclover should do fairly well on areas treated with lime and phosphate.

Clean-cultivated crops should not be grown at frequent intervals on this soil, because it erodes easily when not under a luxuriant close-growing vegetative cover. Rotations should be used that include at least 2 years or more of hay and pasture clovers and grasses and legume cover crops following the cultivated crop. Such legumes as red clover, alfalfa, sweetclover, and lespedeza respond well to lime, and, in general, phosphorus is needed for all crops, especially these legumes. Organic matter in the form of manure or green-manure crops should be added to the soil at regular intervals. Much of this soil that is to be used in a regular rotation probably should be terraced and tilled on the contour.

Memphis silt loam, undulating phase.—This soil of the uplands is formed from loessal material on gently undulating relief (2- to 5-percent slope). Drainage is good. A total area of 3,520 acres is mapped, mostly on narrow ridge tops in the most hilly parts of the county.

The 7-inch surface layer of light grayish-brown smooth silt loam grades into bright yellowish-brown friable heavy-textured silt loam or light-textured silty clay loam, which in turn grades at a depth of about 15 inches into strong or bright yellowish-brown slightly compact somewhat dense silty clay loam that breaks into firm medium-sized sub-angular nutlike aggregates. Below a depth of 27 to 33 inches is dull yellowish-brown friable heavy-textured silt loam to light-textured silty clay loam having a structure similar to that of the overlying layer. Reddish- or yellowish-colored sandy or gravelly Coastal Plain material lies below a depth of 3½ to 7 feet or more, the depth being greatest in the western part of the county. A few iron concretions are in the subsoil.

This medium to strongly acid soil is moderately fertile. The subsoil retains moisture well and allows good circulation of air and penetration of roots. When not protected by a good vegetative cover the soil is subject to erosion and slight gulying, but it is not quite so erosive as Grenada silt loam. Where erosion is moderate or severe, the surface is yellowish brown owing to mixture by tillage of the remaining surface soil with subsoil material.

Crops commonly grown are better suited to this soil than to the Grenada soils, although the leaf of dark fire-cured tobacco grown on this soil is usually lighter, thinner, and of otherwise poorer grade. The present use of this soil is similar to that of Loring silt loam, except that less is planted to tobacco and more is in forest. Yields of most crops average slightly higher than on that soil. Under common management, corn yields about 28 bushels; wheat, 13 bushels; cotton, 270 pounds; strawberries, 70 crates; lespedeza, 0.8 ton of hay; and tobacco, about 750 pounds an acre. After proper applications of lime and fertilizer and when a suitable crop rotation is practiced, corn yields about 42 bushels an acre; wheat, 16 bushels; cotton, 400 pounds; strawberries, 80 crates; and lespedeza, 1½ tons of hay. Alfalfa and sweetclover should do well when the soil is treated with lime and phosphate, and fruit trees should grow well.

Good management, involving production of the crops commonly grown, requires a rotation that includes legume and grass hay or pasture crops and a legume cover crop following clean-cultivated crops. If legumes are to be grown, lime at the rate of about 2 tons an acre should be applied. Organic matter should be added by the return of manure and crop residues and, where necessary, by turning under green-manure crops. Where conditions and crop requirements warrant, phosphate fertilizer should be applied and terraces or other erosion-control devices used.

Memphis silt loam, hilly phase.—This phase has developed on the rougher uplands, principally in the northern and southwestern parts of the county where the covering of loessal material is deeper. External drainage is free and internal drainage good. In all significant profile characteristics and in most other features this soil is similar to the normal phase of the type, but the relief differs mainly in being strongly rolling and hilly (10- to 18-percent slope); also, the surface soil generally is shallower and the subsoil lighter textured and less compact. Moisture relations are poorer and erosion more severe than in the normal phase because of the stronger slopes and greater runoff. The erodibility and degree of erosion are similar to or slightly less than in Brandon silt loam. Heavy farm machinery can be used only with difficulty.

Use of this soil is similar to that of Brandon silt loam, except that a somewhat greater proportion is cropped to corn, lespedeza, and wheat and a correspondingly smaller proportion is in idle open land and forest. It is better suited than that soil, however, to alfalfa, sweetclover, and fruit trees, and yields of all crops are somewhat higher. Suitability for the crops grown and suggestions for use and management of this soil are similar to those for Brandon silt loam.

Mapped with this phase, principally in the northwestern and southwestern parts, is about 1 square mile of a soil resembling Loring silt loam, hilly phase, but differing from it in having greater depth to the slightly compact and mottled-gray lower subsoil. Small areas of Providence silt loam, hilly phase, Brandon silt loam, and Lexington silt loam also are included.

Olivier silt loam.—This soil has developed under conditions of moderate to imperfect drainage on stream terraces from old alluvium composed largely of loessal material from the uplands. In profile characteristics it closely resembles Grenada silt loam, level phase. The relief is nearly level, external drainage is slow but generally adequate, and internal drainage is greatly restricted by the compact lower subsoil, which is slowly to very slowly permeable to water and causes crops to be injured somewhat by extremely wet or dry weather. Erosion control is not a problem on this soil, and erosion that has taken place is negligible. A total of 1,408 acres of the soil is mapped, chiefly on terraces of the East Fork Clarks River near Hardin, Olive, Benton, and Elva; other areas are on terraces of the West Fork Clarks River and Soldier and Jonathan Creeks.

The 8-inch surface layer is grayish-brown or light grayish-brown mellow silt loam. This overlies yellowish-brown friable silt loam that grades to mottled yellow and gray friable light-textured silty clay loam at a depth of about 20 inches. Below a depth of about 26 inches is the pan or hard layer consisting of gray, mottled with yellow and

brown, heavy-textured silty clay loam. Below a depth of about 34 inches the material is mottled gray and yellow and more friable than the layer above. In the vicinity of Elva this soil contains some small mica flakes.

The suitability for use and present use of this soil, the crop yields, and the suggested practices of management are about the same as for Grenada silt loam, level phase.

Mapped with this soil is about a fifth of a square mile having a loam surface soil and a slightly lighter textured subsoil containing variable quantities of sand or gravel. This variation occurs mainly in the vicinity of Elva.

Olivier silt loam, undulating phase.—In profile characteristics this phase resembles the normal phase of this type and differs from it mainly in relief. It has developed under similar drainage conditions. External drainage is good and internal drainage slow. A total area of 896 acres is mapped, chiefly on terraces of the East Fork and West Fork Clarks Rivers, Jonathan and Soldier Creeks, and Lone Valley Branch. If not protected the soil is subject to harmful sheet erosion and slight gulling. Its condition of erosion is similar to that on Grenada silt loam, and the eroded areas are indicated on the map by symbols.

The suitability and present use of this soil, the crop yields, and the suggested practices of management are similar to those for Grenada silt loam.

Mapped with this soil is about a tenth square mile having a loam surface soil, a slightly lighter textured subsoil, and varying quantities of sand or gravel. Also included is a total of about a tenth square mile in which the soil is rolling, the slope being 10 to 15 percent. In the vicinity of Elva some small mica flakes are present.

Providence silt loam.—This soil has developed on upland slopes of 5 to 10 percent under imperfect drainage conditions from a shallow covering of loessal material less than 42 inches thick over gravelly or sandy Coastal Plain material. It is similar in profile characteristics to Loring silt loam, rolling phase, but differs in the character of parent material, the upper part of the profile having been derived from acid loess and the lower part wholly or partly from Coastal Plain material consisting of unconsolidated sand, clay, and gravel. A total of 10,048 acres occurs in relatively small scattered areas throughout the uplands.

Under virgin conditions, the upper ½- to 1-inch layer consists of dark grayish-brown silt loam containing much organic matter in varying stages of decomposition. This thin layer is underlain by a 4- to 6-inch grayish-brown mellow silt loam layer and this, in turn, by yellowish-brown friable heavy-textured silt loam. The subsoil below a depth of about 22 inches is a yellowish-brown, rusty-brown, and gray somewhat friable but slightly compact silty clay loam or clay loam. At a depth of 26 to 32 inches this layer is underlain by a gray sandy clay or heavy-textured clay loam lower subsoil, mottled with yellow and rusty brown, and containing varying quantities of sand or gravel, or both. It is moderately to slightly compact and dense and breaks into firm to hard subangular aggregates. Below a depth of 35 to 45 inches the material is less gray, less compact and dense, and passes with increased depth into layers of gravel and, in places,

sand. The gravelly or sandy material generally is unconsolidated but in places contains layers or lenses cemented by ferruginous compounds into sandstone or conglomerate rocks.

Dusky reddish-brown and dark-colored soft to semihard concretions are throughout the profile and generally are most numerous in the gray mottled layer. The quantity of sand and gravel in the subsoil and the depth at which they occur vary, but appreciable quantities everywhere are above a depth of about 42 inches. When the soil is cleared and cultivated, the organic matter in the thin upper layer becomes mixed with the rest of the surface soil, and much of it is soon lost by erosion, leaching, and heavy cropping. In cultivated fields the surface soil is light grayish brown, the thickness depending on the extent of accelerated erosion. The reaction is strongly acid throughout the profile.

When poorly managed this soil is subject to severe sheet and gully erosion. Erosion, moisture, and tilth conditions are practically the same as in Loring silt loam, rolling phase, although about 12 percent of the total area has been moderately gullied and about 6 percent severely gullied.

The present use of this soil and the crop yields are practically the same as those of Loring silt loam, rolling phase. Probably 11 percent of the total area is in forest; 9 percent is used for corn, 8 percent for lespedeza, 5 percent for wheat, 1 percent each for strawberries, cotton, redtop, soybeans, and tobacco, and 2 percent for farmsteads. The rest is idle open land. Under prevailing management, corn yields about 18 bushels an acre; wheat, 8 bushels; cotton, 170 pounds; strawberries, 45 crates; lespedeza, 0.5 ton of hay; and tobacco, about 575 pounds. With proper applications of lime and fertilizer and other good practices of management, corn yields about 26 bushels an acre; wheat, 11 bushels; cotton, 250 pounds; strawberries, 55 crates; and lespedeza, 1 ton of hay.

The suitability for crops and the suggested management of this soil are practically the same as for Loring silt loam, rolling phase.

Providence silt loam, hilly phase.—A total of 3,392 acres of this soil occurs in scattered areas over the rougher uplands, principally in the western part of the county where the covering of loessal material is thicker. It is similar to the normal phase of the type in all significant profile characteristics, composition of parent material, and most other respects, differing mainly in being strongly rolling and hilly (10- to 18-percent slope) and in having a slightly shallower surface soil and a less gray and less compact lower subsoil. External drainage is free and internal drainage slow to good.

This phase has poorer moisture relations and more erosion than the normal phase because of its stronger slope and consequent greater runoff. Its erodibility and degree of erosion are similar to those of Brandon silt loam. Heavy types of farm machinery are used with difficulty.

The present use of this phase is similar to that of Brandon silt loam, except that somewhat more of it is planted to corn, lespedeza, and redtop, and less is idle open land. It is a slightly better soil, however, and the crop yields are possibly a little higher. Suitability for crops and suggestions for management are also similar to those for the Brandon soil.

Mapped with this phase are areas of Brandon and Lexington silt loams and Memphis silt loam, hilly phase, which are too small for separation on the small-scale map.

Rough gullied land (Brandon soil material).—Gullies ranging from 1½ to 10 feet deep or more affect 50 percent or probably a little more of this land type. This severe damage by sheet and gully erosion prevents the use of farm machinery. Small spots between gullies retain part of the original surface soil and furnish scant pasture. Many of the areas represented on the map by several gully symbols are as severely gullied as the delineated areas but are too small to be outlined on the map. A total of 2,048 acres is mapped in fairly small areas distributed over most of the rolling and hilly parts of the county on slopes of 5 to 18 percent or considerably more.

As this rough gullied land is practically valueless for crops and pasture, its restoration for such uses probably would be infeasible. The land can be used for growing trees during and after checking erosion, and apparently its best use is for forest.

Originally this was one of the Brandon soils, though very small areas of severely gullied Grenada, Loring, Memphis, Providence, Lexington, and Bodine soils are mapped with it.

Sciotoville silt loam.—This important agricultural soil has developed under imperfect drainage conditions on slopes of 3 percent or less on terraces of the Tennessee River from deposits of alluvial materials. These materials were derived from many different kinds of soils and rocks in the Tennessee River drainage basin but mainly from limestone and soils developed from limestone materials. External drainage is slow to good, and internal drainage is restricted by the moderately compact lower subsoil but not so much so as in Grenada silt loam. Tilth conditions are moderately good, and erosion has only slightly affected the soil.

This soil covers a total of 6,208 acres, occurring in association with its slope phase, Sciotoville very fine sandy loam, and Wheeling and Weinbach silt loams on long and relatively wide terrace ridges along and nearly parallel to the Tennessee River. The ridges are separated from the first bottoms in many places by steep slopes or escarpments. These ridges are 10 to 20 feet above the first bottoms and above the normal overflow of streams, though exceptionally high floodwaters may cover some of the lower lying areas.

Under virgin conditions the first half inch of surface soil is dark grayish brown and contains considerable organic matter. In cultivated areas the surface soil consists of a 6- to 7-inch light-brown or slightly grayish-brown friable silt loam underlain by yellowish-brown friable silt loam to a depth of about 12 inches. The yellowish-brown slightly compact silty clay loam subsoil below a depth of 18 to 22 inches overlies mottled yellowish-brown, gray, and rusty-brown slightly compact silty clay loam; and below a depth of 27 to 32 inches the subsoil is gray heavy-textured silty clay loam or clay loam, mottled with yellowish brown and rusty brown, which is moderately compact when dry and slightly plastic and sticky when wet. Below a depth of about 45 inches the material is less grayish and more brownish colored, less compact, and lighter textured, though generally clay loam. The substratum, consisting of stratified and generally medium to light-textured old alluvium, lies below a depth of 72 to 96 inches.

The entire soil contains varying quantities of small mica flakes. The surface soil and upper subsoil generally contain few to moderate quantities of small dusky reddish-brown and dark-colored soft and semihard concretions, and the gray mottled lower subsoil contains numerous dusky reddish-brown and dark-colored soft to hard concretions and is not easily pervious to roots. The profile is medium to strongly acid throughout.

Probably 2 percent of the total area of this soil is in forest; 22 percent is used for corn, 13 percent for wheat, 12 percent for lespedeza, 5 percent for redtop, 4 percent for soybeans and cowpeas, 2 percent each for strawberries, cotton, and oats, 1 percent for tobacco, and 4 percent for farmsteads and orchards; about 31 percent is idle open land.

Most of the crops grown, except principally dark fire-cured tobacco, are somewhat better adapted to this soil than to Grenada silt loam, level phase. This soil is slightly higher in fertility than the soils of the uplands, and it responds well to good management. Lime has been applied to about 10 percent of its total area, and land for about 10 percent of the corn, 50 percent of the wheat, and 35 percent of the strawberries and cotton grown is fertilized mainly with 20-percent superphosphate at a rate of about 100 pounds an acre. Practically all the tobacco is fertilized with about 100 pounds an acre of a complete fertilizer, depending on other management practices.

Under common management corn yields about 26 bushels; wheat, 14 bushels; lespedeza, 0.9 ton of hay; strawberries, 70 crates; and cotton, 320 pounds an acre. With proper applications of lime and fertilizer and other good practices of management, corn yields about 40 bushels; wheat, 18 bushels; lespedeza, 1½ tons of hay; strawberries, 85 crates; and cotton, 440 pounds to the acre. Under common management tobacco yields about 800 pounds an acre, though the grade generally is not so good as that of the tobacco grown on the Grenada soils. Strawberries and cotton are better suited to this soil than dark fire-cured tobacco. Deep-rooted crops, as alfalfa and sweetclover, and also fruit trees are not well suited because of the imperfectly drained subsoil. Redtop, timothy, soybeans, cowpeas, and most vegetables do fairly well, but an application of lime is necessary for growing alfalfa, sweetclover, and red clover.

To maintain this soil in a high state of productivity it is advisable to apply lime, practice crop rotations that include legumes and grasses, follow all cultivated crops with cover crops, and add organic matter through the use of barnyard manure and crop residues. Applications of phosphate would probably prove economical, though apparently this fertilizer is not required in so large quantities as by the soils of the uplands. Applications of nitrogen, phosphate, and potash are advisable for cotton.

Mapped with this soil on some of the ridges nearer the river, especially where the soil is associated with Sciotoville very fine sandy loam, are areas in which the surface soil is smooth loam and the subsoil light-textured clay loam.

Sciotoville silt loam, slope phase.—Stronger slopes (3 to 7½ percent) of this phase effect differences from the normal phase of the type in drainage, erosion, and thickness of surface soil. In significant profile characteristics and in parent material, however, this soil

is similar to the normal phase. External drainage is good, but internal drainage is moderately slow because of the moderately to slightly compact lower subsoil.

This soil occupies a total area of 1,216 acres on terraces of the Tennessee River, generally between areas of the normal phase and the first bottoms. It lies above the usual flooding by the adjacent streams, though high water covers the lower lying areas. Under poor management it is subject to rather severe sheet and gully erosion. Eroded areas are indicated on the map by symbols.

About 7 percent of this phase remains in forest; 13 percent is used for corn, 4 percent for lespedeza, 4 percent for wheat, 2 percent for soybeans and cowpeas, 1 percent for redtop, 2 percent for other crops, 5 percent for farmsteads and orchards; 62 percent is idle open land.

Fertilizer practices are similar to those for the normal phase, but crop yields are about 15 percent less. The use suitability is about the same for both soils. Because of the stronger slope and erosion risk, considerable care must be taken in cropping this phase. Contour tillage is advisable, and terraces or other measures for controlling erosion should help, especially on the more sloping land. Other suggestions for management of this phase are the same as for the normal phase.

Mapped with this phase are a few areas in which the surface soil is loam or very fine sandy loam and the subsoil lighter textured than common.

Sciotoville very fine sandy loam.—This soil, developed on slopes of 3 percent or less under imperfect drainage conditions on terraces of old alluvium deposited chiefly by the Tennessee River, differs from Sciotoville silt loam mainly in having a slightly coarser texture. External drainage is slow to good, and although internal drainage is restricted to some extent, it generally is better than in Sciotoville silt loam. A total of 640 acres is mapped on long, relatively wide ridges on terraces of the Tennessee River, mainly in the vicinity of Calvert City and Gilbertsville. The soil lies 10 to 20 feet above the first bottoms, is not overflowed by the usual floods, and is subject to only slight sheet erosion. It has very good tilth conditions and can be easily worked under a considerable range of moisture conditions.

Under virgin conditions the first half inch of the surface soil is dark grayish brown and contains considerable organic matter. In cultivated areas the 6- to 7-inch brown, light-brown, or slightly grayish-brown mellow very fine sandy loam surface soil is underlain to a depth of 11 to 15 inches by very friable yellowish-brown loam or heavy-textured very fine sandy loam. This overlies yellowish-brown moderately friable but slightly compact light-textured clay loam, which grades at a depth of about 21 inches into mottled yellowish-brown, gray, and rusty-brown fairly friable but slightly compact light-textured clay loam. Below a depth of 30 to 34 inches the material is more gray and less yellow, slightly heavier in texture, and slightly more compact, and below a depth of 42 to 45 inches it has less gray and more brown, is more friable, and generally consists of light-textured clay loam.

A moderate quantity of small mica flakes is distributed through the profile. The upper and middle parts contain a few small soft dusky reddish-brown and dark-colored iron concretions, and the

lower part contains numerous larger, soft to semihard dusky reddish-brown and dark-colored iron concretions. The lower subsoil varies from slightly compact to moderately compact in different areas, but it is generally fairly pervious to roots. The profile is medium to strongly acid throughout.

This soil is fairly well suited to a variety of crops. It is about equal to Sciotoville silt loam in fertility but responds slightly better to good management. All of it has been cleared, and probably 23 percent is used for corn, 20 percent for wheat, 9 percent for oats, 5 percent for lespedeza, 3 percent for soybeans and cowpeas, 1 percent each for cotton and redbud, and 2 percent for farmsteads. About 36 percent is idle open land. This soil is better suited than Sciotoville silt loam to cotton but more poorly suited to dark fire-cured tobacco; otherwise, the suitability of both soils for crops and the crop yields are about the same. The present management practices and suggestions for management of the Sciotoville silt loam also are practically the same as for the silt loam.

Shannon loam.—Agriculturally, this is a fairly important soil and one of the most productive in the county. It has formed on first bottoms under good natural drainage conditions from alluvium deposited by creeks and smaller rivers and derived largely from soils developed from a shallow layer of loessal material overlying Coastal Plain material. Except in texture and in character of the parent material it is similar to Vicksburg silt loam. A total area of 3,200 acres is mapped in nearly level flood plains of creeks and smaller rivers traversing the more hilly parts of the county, especially those occupied by Brandon, Lexington, or Providence soils. External drainage is good to slow. The subsoil allows good percolation of water, and the water table is low enough not to interfere with good drainage. The soil is subject to periodic flooding by adjacent streams, and during overflow alluvial material may be deposited or channels may be scoured out by the running water. Areas near the West Fork Clarks River Drainage Ditch seldom are flooded.

To a depth of about 8 inches the surface soil is light-brown, in places light grayish-brown, mellow loam. It is underlain by light-brown or slightly yellowish-brown very friable loam, which with depth is more yellowish colored in many places. The subsoil is porous and easily permeable to air and roots. In many places the lower part of the profile is stratified and contains light-textured material ranging from loam to gravelly loam in places. Varying quantities of gravel occur throughout the profile, and areas in which the surface soil is gravelly are indicated on the map by symbols.

Appreciable quantities of small mica flakes are in some areas, especially along Jonathan Creek. Organic-matter content is low, and in wooded areas the first inch of the surface soil has only a slight accumulation. The entire profile is strongly to medium acid. Tilth conditions are excellent. The texture of the surface soil varies in some areas, being silt loam, fine sandy loam, loamy sand, or gravelly loam.

This soil has practically the same use and suitability for crops and, where containing only small quantities of sandy and gravelly materials, is as productive as Vicksburg silt loam. The crops are not so resistant to drought, however, and yields are 5 to 10 percent less. Suggestions for management are the same as for Vicksburg silt loam.

Tigrett cherty loam.—This recent to young soil, formed from local alluvium and colluvium composed of materials washed mainly from Bodine, Brandon, and Lexington soils, is similar to Tigrett loam in relief, mode of occurrence, and susceptibility to flooding but differs in texture, or in being cherty. Drainage is good, but the water-holding capacity of the soil is relatively low. A total area of 384 acres is mapped in the well-dissected eastern part of the county in association with the Bodine soils.

The surface soil is grayish-brown or light-brown loam, and the subsoil light-brown very friable generally stratified loam. Both surface soil and subsoil contain many angular chert fragments as much as 3 inches or somewhat more in size (pl. 6, *B*). Varying quantities of rounded gravel are in many places. The soil is medium to slightly acid and has a relatively low content of organic matter. The textures of the surface soil and subsoil vary greatly from place to place.

Except for a larger proportion in idle open land and a correspondingly smaller proportion used for corn, the use of this soil and its suitability for crops are the same as for Tigrett loam. The yields are rather low because of the generally cherty and gravelly character of the soil. Corn yields about 20 bushels an acre, and the yields of other crops are 30 to 35 percent less than on Tigrett loam. The suggestions for management of this cherty soil are the same as for Vicksburg silt loam.

Tigrett loam.—This agriculturally important recent to young soil has formed on local alluvium and colluvium derived mainly from soils formed from a thin layer of loessal material on unconsolidated Coastal Plain material. Covering a total of 5,568 acres in the more rolling and hilly parts of the county on slopes of 4 percent or less, it lies above the ordinary overflow of the streams, but the lower lying areas may be flooded by exceptionally high water. External drainage is slow to good, and internal drainage good.

This soil is similar to Shannon loam in profile characteristics, including parent material, but differs in mode of occurrence—it occupies very gently sloping and gently sloping positions at the base of hills, very gently sloping alluvial fans of small streams entering the flood plains of larger creeks, or narrow U-shaped bottoms along deeply entrenched small streams. The subsoil is slightly more yellowish or reddish colored than in Shannon loam, and the textures of the surface and subsoil vary more. The variations from type are similar to those of Shannon loam, and the more gravelly and sandy soil dries out more readily and is less productive than Tigrett loam.

This soil may be better used than Shannon loam for a wider variety of crops, including strawberries, tobacco, wheat, and cotton, because of less risk of injury to the crops by floods. Possibly 14 percent of it is in forest, 22 percent is used for corn, 13 percent for lespedeza, 5 percent for wheat, 4 percent for soybeans and cowpeas, 3 percent for strawberries, 3 percent for redtop, 2 percent for tobacco, 1 percent for cotton, and 2 percent for minor crops and farmsteads. About 31 percent is idle open land. Some areas of lighter texture are used for melons that do well. The tobacco generally grown is of coarse quality. Wheat grows well. The soil is considered one of the best in the county for strawberries and raspberries.

Under common farm practices, in which no lime or phosphate is used, corn yields about 34 bushels an acre; and with some fertilization wheat averages about 14 bushels; strawberries, 85 crates; cotton, 280 pounds; and lespedeza, 1 ton of hay. With good practices, including the use of lime and phosphate, corn yields about 45 bushels; wheat, 17 bushels; strawberries, 90 crates; cotton, 520 pounds; and lespedeza, 1.7 tons of hay an acre. Tobacco yields about 925 pounds an acre when a complete fertilizer is applied. Only a very small acreage has been limed, and commercial fertilizer is rarely used except for tobacco. Deep-rooted legumes thrive when the soil has been limed. Vegetables grow well, and fruit trees are suited to the soil. The suggestions for management of this soil are the same as for Vicksburg silt loam.

Vicksburg silt loam.—Under good drainage conditions this soil has formed from an alluvium of loessal material deposited by creeks and small rivers. It covers a total of 3,584 acres on first bottoms, the principal areas being on the flood plains of the East Fork Clarks and West Fork Clarks Rivers and some of their tributaries. External drainage is slow to good, and the subsoil permits good percolation of water, has good water-holding capacity and aeration, and is freely penetrated by roots. The workability and tilth conditions of the soil are excellent. Crops withstand drought well, but the soil everywhere is subject to the usual flooding that seldom lasts longer than 2 days. Scouring by floods occurs in places, whereas new material is deposited in other places.

The surface soil is brown to light grayish-brown smooth mellow silt loam to a depth of about 8 inches. It overlies brown to light-brown very friable silt loam, generally to a depth of 36 inches or more. In many places the lower layer is slightly yellowish or faintly reddish colored. In places small mottles of gray and rusty brown appear and dark-colored iron concretions may occur below a depth of 36 inches. Below this depth the parent material, stratified in many places, consists of friable silt loam, loam, or sandy loam. The soil is strongly to medium acid. Although the organic-matter content is low, it is somewhat higher than in the soils on the uplands and terraces.

Gravel or appreciable quantities of sand are in the surface soil and subsoil in places, especially near stream channels where creeks have overflowed and deposited coarser textured materials. In many scattered areas the soil is silt loam to a depth of about 24 inches, where it is underlain by fine sandy loam or very fine sandy loam.

Although this soil is one of the most productive in the county, periodic flooding somewhat limits its suitability for crops. Probably 64 percent of it is used for corn, 4 percent for lespedeza, 3 percent for cotton, 2 percent each for wheat, redtop, and soybeans (including cowpeas), and 1 percent each for tobacco and strawberries; about 10 percent is in forest and 11 percent in idle open land. The present forest growth consists predominantly of white, red, black, post, Southern red, and swamp chestnut oaks, sweet-gum, black tupelo (black-gum), sycamore, beech, tuliptree, silver maple, and river birch.

Because of good moisture relations, moderate fertility, and good workability this soil is one of the best in the county for corn, which is grown continuously in many places for several years. Only a small acreage has been limed. Fertilizer is seldom used except for tobacco.

Corn yields about 38 bushels an acre under common management, with little or no fertilization, and about 50 bushels where lime and phosphate are applied and the better cultural practices followed. Corn failures are rare.

Tobacco yields about 750 pounds an acre, but owing to flooding and to diseases there is much risk in growing it; furthermore, the tobacco tends to be of coarse quality and generally sells at a low price. Wheat yields about 8 bushels without lime and phosphate and 14 bushels with them, but growing it is also risky owing to winter and spring floods. Lodging also may result from the rank growth the wheat makes. The grain is often chaffy and mixed with wild onion and other weed seeds. Lespedeza, redbot, timothy, cowpeas, and soybeans do well. Lespedeza yields about 1 ton of hay an acre; timothy, 1½ tons; redbot, 1 ton without lime or phosphate; and cowpeas and soybeans, often used for replacing after spring floods, 1½ tons. Strawberries and raspberries do very well if protected from floods, but their production is risky on areas subject to flooding.

In the management of this soil better results may be expected if a rotation including legumes and grasses is followed; organic matter is added by the use of barnyard manure, green manure, or crop residues; a light application of lime is made; and phosphate is applied.

Waverly silt loam.—This recent soil of the flood plains of the creeks and smaller rivers, formed under poor drainage conditions from alluvium composed chiefly of loessal material, differs from Collins silt loam in having a gray mottled surface soil and poor drainage. The soil is level or depressed; external drainage is poor. Internal drainage is ordinarily fairly good, but frequently the water table is high and causes drainage to be poor. This is the most extensive soil of the bottom lands, occupying a total of 9,856 acres generally some distance from creek and river channels. Large areas are in the bottoms along the East Fork and West Fork Clarks Rivers and Jonathan and Cypress Creeks, and smaller areas are in the bottoms along other creeks. A few areas are swampy and are indicated on the map by symbols. The soil is easily overflowed by the usual floods of the adjacent streams, and alluvial materials are deposited in some places and materials removed by scouring in others. Areas near the West Fork Clarks River Drainage Ditch seldom are flooded.

The surface soil of medium-gray or gray mellow silt loam, mottled with light brown, rusty brown, and yellow, is underlain at a depth of 5 to 10 inches by light-gray friable silt loam, mottled with rusty brown, yellow, and grayish brown. When dry, the surface of cultivated fields has a light-gray color of brownish tint. In wooded areas the first inch or two of the surface is slightly darker colored, caused by a small accumulation of organic matter. Below a depth of 36 inches or slightly more the substratum is silt loam, loam, or fine sandy loam, and is stratified in many places.

Because of numerous dusky reddish-brown and dark-colored soft to hard iron concretions on and in the soil it is called by many "buck-shot land" and by others "white land" or "crawfishy land." The soil is strongly acid and low in organic matter. Roots easily penetrate the profile. In some areas, especially along Jonathan Creek, many small mica flakes are distributed through the soil.

Perhaps 20 percent of this soil is in forest; 35 percent is used for corn, 5 percent for lespedeza, 4 percent for redtop, and 2 percent for soybeans and cowpeas. About 31 percent is idle open land, and the rest is used for crops of minor acreage, mainly sorghum cane, strawberries, tobacco, and wheat. Poor drainage and flood hazards limit the use of the soil for crops. The success of crops depends greatly on the nature of the season; in dry seasons the crops succeed about as well as on Collins silt loam, but crops fail from excessive moisture one in about 4 or 5 years.

Corn, redtop, lespedeza, cowpeas, soybeans, sorghum cane, and water-tolerant grasses are best adapted to this soil. Tobacco, cotton, wheat, strawberries, and deep-rooted legumes are poorly adapted because of the excessive water in the soil at times. Under general practices corn yields about 22 bushels an acre; tobacco, 550 pounds; lespedeza hay, 0.8 ton; redtop hay, 1 ton; and soybean hay, 1.2 tons without lime or fertilizer. The tobacco produced tends to be coarse and of low grade. In many places hay crops are damaged by sediment deposited during floods. The spring-sown crops generally are planted late in the season. Only a small acreage of the soil has been limed, and fertilizer is rarely used except for tobacco.

Swampy areas can be used for permanent pasture; and with proper management, including the lowering of the water table by sufficient artificial drainage, the other areas can be used to good advantage for field crops. Open ditches drain the soil well in the few places used. Tile is not used, but either tile or open ditches should provide adequate drainage. When good drainage has been established, it is important that the crop rotation include a leguminous crop and that lime, phosphate, organic matter, and possibly potash be added.

Weinbach silt loam.—An aggregate area of 9,792 acres of this soil is on terraces of the Tennessee River or on adjacent terraces. It is developed on stream terraces under poor drainage conditions from old alluvium deposited principally by the Tennessee River and is called "white land" or "buckshot land." In most profile characteristics it is similar to Calloway silt loam. The relief is nearly level or slightly depressed (less than 2-percent slope). External drainage is slow to poor, and water remains on the surface in some places for a considerable time after heavy rains. Internal drainage is very slow. Many of the areas are along swales or drainageways bordered by ridges occupied by Sciotoville or Wheeling soils. A few areas are swampy and are indicated on the map by symbols. The lower lying soil is overflowed by high floods.

In cultivated fields the surface soil is light-gray friable silt loam, mottled with yellow, grayish brown, and rusty brown, underlain at a depth of 10 inches by slightly heavier textured but friable material. Below a depth of 21 to 30 inches the subsoil is gray, faintly mottled with rusty brown and yellow, silty clay or silty clay loam of very plastic and sticky consistence when wet. It is very compact and dense and breaks into fairly large subangular nutlike aggregates that are hard when dry. With increased depth, below about 50 inches, the subsoil is less gray and more yellow, less dense, and lighter textured. The substratum consists of stratified old alluvium.

A moderate quantity of small mica flakes and many rusty-brown and black soft to hard iron concretions are throughout the soil. In

cultivated fields the content of organic matter is low, but in wooded areas a very thin upper surface layer contains a fair quantity. Tilt conditions are fair. The surface soil tends to pack and clod when dry and run together after hard rains. The very slowly permeable subsoil greatly restricts roots and limits internal drainage; consequently, in wet seasons water collects above it and prevents good circulation of air, bacterial action, and other processes favorable to crop production. The soil is strongly to very strongly acid throughout.

About 27 percent of this soil is in forest; about 17 percent is used for corn, 6 percent for wheat, 4 percent for redtop, 3 percent for soybeans and cowpeas, and 2 percent for lespedeza. Perhaps 36 percent is idle open land, and the rest is used for minor crops, mainly sorghum cane, oats, and strawberries, and for homesteads. The suitability of the soil for crops and crop yields are similar to those of Calloway silt loam except that its suitability for tobacco is not nearly so good and for wheat somewhat poorer. The crop yields depend largely on the season, being materially reduced either in wet weather or in extremely dry weather. Only a small acreage has been limed or fertilized.

The suggestions for managing this soil are practically the same as for Calloway silt loam. A few areas have been partly drained by open ditches, and in the adjoining county some areas of the same type of soil have been adequately drained by tile. The swampy areas, indicated on the map by symbols, would probably be best for permanent pasture.

Wheeling silt loam.—This fertile and productive soil is developed under good drainage conditions on stream terraces from old alluvium deposited chiefly by the Tennessee River. The relief is level to gently undulating (0 to 3 percent). External drainage is slow to good and internal drainage good. The soil has good water-holding capacity and is subject to little or no erosion. It covers a total of 1,600 acres on long but generally rather narrow ridges on the Tennessee River terraces. The ridges lie above the usual floods and in many places are bordered by short escarpments or steep slopes separating them from the first bottoms.

To a depth of 6 to 8 inches the surface soil is light-brown or slightly grayish-brown mellow silt loam underlain by about a 5-inch layer of yellowish-brown friable heavy-textured silt loam. Below this the subsoil is yellowish-brown or brown slightly to moderately compact and somewhat friable silty clay loam or heavy-textured clay loam, which breaks into firm subangular medium-sized aggregates coated on the outside with brown very fine-textured material. Below a depth of about 30 inches the subsoil generally is less bright in color, lighter textured, less compact, and more friable, and at a depth of 45 to 50 inches it gives way to light-brown or brownish-yellow loam or rather friable light-textured clay loam containing an appreciable quantity of fine sand in most places. Rusty-brown mottlings and in places gray mottlings appear. This material overlies old alluvium of stratified light-textured and heavy-textured materials.

In wooded areas the surface soil to a depth of half an inch contains considerable organic matter and is dark grayish brown. The entire profile contains an appreciable quantity of fine mica flakes. Small

black or rusty-brown stains or soft concretions are in the subsoil but rarely in the surface soil. The soil is medium to strongly acid throughout.

This soil is fairly well suited to many different crops; about 40 percent is used for corn, 14 percent for wheat, 8 percent for oats, 6 percent for redtop, 5 percent for lespedeza, 2 percent each for soybeans and cowpeas, other crops, forests, and farmsteads, and 19 percent is idle open land.

Crop yields are considerably above the average for the soils of the county. Under common farm practices corn yields about 31 bushels an acre; wheat, 16 bushels; cotton, 360 pounds; strawberries, 75 crates; lespedeza, 1 ton of hay; and redtop, 0.8 ton of hay. With proper applications of lime and fertilizer and with other better management practices, corn yields about 45 bushels an acre; wheat, 20 bushels; cotton, 520 pounds; strawberries, 90 crates; and lespedeza, 1.8 tons of hay. Very little tobacco is grown because of inferior grade. Oats, soybeans, cowpeas, and timothy do well. Under better management practices, including sufficient applications of lime, alfalfa, sweetclover, and red clover should produce well. Raspberries, peaches, and apples are well adapted to this soil. Suggestions for management are similar to those for Sciotoville silt loam.

Mapped with this soil is a total of about 1 square mile of a smooth phase, which is similar to the normal phase in significant profile characteristics, including parent material, but differs chiefly in being gently undulating to gently rolling (3- to 7-percent slope), with resultant differences in depth of surface soil and conditions of drainage and erosion. Both external and internal drainage are good. Although this smooth phase is above the usual flooding, the lower lying areas are inundated by high floods. Under poor management the soil is subject to rather severe sheet and gully erosion. The eroded areas are indicated on the map by symbols. This phase occupies positions on terraces of the Tennessee River between areas of the normal phase and soils in the first bottoms. About 8 percent of it is in forest, 35 percent in idle open land, and 2 percent in farmsteads; 24 percent is used for corn, 10 percent for wheat, 5 percent for soybeans and cowpeas, 6 percent for redtop and timothy, 4 percent for oats, 3 percent for lespedeza, 1 percent for cotton, and 2 percent for other crops. Fertilization and other management practices and suitability for crops are similar to those for the normal phase, but crop yields are about 15 percent less. Suggestions for management are the same as for Sciotoville silt loam, slope phase.

Wheeling silt loam, slope phase.—In significant profile characteristics and in parent material this phase is similar to the normal phase of the type. It differs chiefly in being on slopes of 7 to 15 percent and in the resultant depth of the surface soil and conditions of drainage and erosion. External drainage is free and internal drainage good. Although this soil is above the usual overflow of the streams, the lower lying areas may be flooded by high water. Where management is poor the soil is subject to severe sheet and gully erosion. Eroded areas are indicated on the map by symbols. The total of 1,024 acres of this soil is on terraces of the Tennessee River, generally between areas of the normal phase and soils of the first bottoms.

About 30 percent of this phase is in forest, 32 percent is idle open land, 20 percent is used for corn, 8 percent for wheat, 4 percent for redtop and timothy, 2 percent for lespedeza, 1 percent for oats, and 3 percent for farmsteads and orchards. It is fertilized and otherwise managed about the same as the normal phase of the type and has similar suitability for crops, except intertilled crops, for which it is less well suited because of its stronger slope and greater susceptibility to erosion. Crop yields are about 30 percent less than on the normal phase.

Suggestions for the use and management of Sciotoville silt loam also apply to this soil. In addition, great care must be taken in practices of cropping in order to control erosion. Contour tillage and terraces or other erosion-checking measures are necessary to control erosion when intertilled crops are grown.

Mapped with this soil are a few areas of slope phase of Wheeling very fine sandy loam that are similar to this soil except in having a slightly coarser texture. External drainage is free and internal drainage good. Although this included soil lies above the usual overflow of streams, high floods may inundate the lower areas. All of it is on terraces of the Tennessee River, generally between ridges of Wheeling very fine sandy loam and soils of the first bottoms. Under poor management it is subject to severe sheet and gully erosion, and the eroded condition is similar to or slightly less than on Memphis silt loam. Its present use, suitability for crops, crop yields, and suggestions for management are the same as for Wheeling silt loam, slope phase.

Wheeling very fine sandy loam.—This soil is formed under good drainage conditions from old alluvial deposits. It is one of the most fertile and productive in the county and is similar to Wheeling silt loam in most respects except texture. The relief is nearly level to gently undulating, the slopes being 3 percent and less. External drainage is slow and internal drainage good. The soil is subject to little or no erosion, has good tilth conditions, is very easy to work, and has medium water-holding capacity. It covers a total of 1,280 acres on long and generally rather narrow ridges on terraces of the Tennessee River. These ridges lie above the normal stream overflow and in most places are bordered by short escarpments or by areas of Wheeling silt loam, slope phase, which separate them from the first bottoms.

To a depth of 6 to 8 inches the surface soil is light-brown or brown mellow very fine sandy loam underlain by a 4- to 5-inch layer of yellowish-brown very friable heavy-textured very fine sandy loam or heavy-textured loam. Below this the subsoil is yellowish-brown to brown clay loam or heavy-textured clay loam of slightly compact but rather friable consistence, grading at a depth of 30 to 35 inches into yellowish-brown or brown friable very fine sandy loam to light-textured clay loam. The substratum in most places consists of sandy stratified layers and of material slightly heavier textured though predominantly sandy. The profile in general is moderately to highly micaceous and medium to strongly acid, but the upper part in some places is slightly acid.

The use of this soil is similar to that of Wheeling silt loam, except that slightly more cotton and strawberries are grown. The same crops

grow as on that soil, but since it is slightly warmer they are a little earlier. The soil is better suited to cotton than any other soil in the county, yielding about 400 pounds an acre under average management and about 540 pounds with the use of proper fertilizer. Other crop yields and management practices and requirements are similar to those on Wheeling silt loam.

Mapped with this soil is about two-fifths of a square mile of a smooth phase that is similar to the normal phase of the type in significant profile characteristics and developed from similar parent material but differs principally in having slopes of 3 to 7 percent and in resultant erosion conditions. Under poor management this included soil is subject to harmful sheet and gully erosion, and its eroded condition is like or slightly less than that of Memphis silt loam. The soil has good drainage and lies above usual overflow, but the lower lying areas may be inundated by high floods. All areas of this included soil are on terraces of the Tennessee River, generally between ridges of Wheeling very fine sandy loam and the first bottoms. The present use, suitability for crops, yields, and suggested management practices are practically the same as for Wheeling silt loam.

Wheeling loamy fine sand.—This soil, developed under good drainage conditions on terraces of the Tennessee River from old alluvium deposited chiefly by that river, is similar to Wheeling very fine sandy loam in most respects except texture. The relief is level to gently rolling (0 to 10 percent). Drainage is free, and crops are subject to considerable injury during droughts. Little or no erosion occurs, and the soil is very easily worked. A total of only 128 acres occurs in long rather narrow areas on ridges that lie above the usual overflow of the streams, mostly in the vicinity of Collie School.

To a depth of about 7 inches the soil consists of light-brown or brown loamy fine sand or loamy very fine sand. The subsoil is yellowish-brown to strong yellowish-brown mellow light-textured very fine sandy loam. Below a depth of 20 inches the subsoil is more yellow but has the same texture and consistence and at a depth of about 45 inches generally passes into reddish-yellow fine sand. The substratum consists of stratified light- to medium-textured materials. The soil is highly micaceous, and generally the upper layer is slightly acid, below which the reaction is slightly to medium acid.

The present use, suitability for crops, and suggestions for management of this soil are somewhat similar to those of Wheeling very fine sandy loam, but because of its low water-holding capacity and sandy nature crop yields are about 25 percent less.

PHYSICAL LAND CLASSIFICATION

The soils of Marshall County differ widely in physical characteristics and consequently in use suitability and management needs. Such differences are caused by a number of soil features, as texture, structure, consistence, quantity and character of organic matter, chemical character (including reaction), moisture conditions, profile depth, accelerated erosion, chertiness, and slope, or lay of the land. These features affect land use and management through their influence on the productivity, workability, and conservability of the soil.

Productivity, as used here, refers to the ability of the soil to produce crops under the prevailing farming practices. The soil may be productive of a crop but not well suited because of its poor workability or conservability, or both. Workability refers to ease of tillage, harvesting, and other field operations. The following characteristics affect workability: Texture, structure, consistence, moisture conditions, organic matter, stoniness, and slope, or lay of the land. Conservability refers to the ease of maintaining the productivity and workability of the soil when it is cultivated.

The best soil for crops is one that is very productive, is easily worked, and can be conserved with minimum effort. Such a combination of features, however, is rare. All the soils in this county fall short of the ideal, but they differ widely in the degree of shortcoming. The soils are placed in five classes so that their relation to agriculture may be discussed more conveniently. These classes in descending order of desirability of the soils for the present agriculture are First-class soils, Second-class soils, Third-class soils, Fourth-class soils, and Fifth-class soils.

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

FIRST-CLASS SOILS

Physically, First-class soils constitute very good to excellent cropland under the management commonly practiced. They differ in degree of profile development, character of parent material, color, and structure and in other respects, but they are relatively similar in general physical suitability for agricultural use. All are fairly well supplied with plant nutrients, compared with other soils of the county, but even the most fertile is responsive to additions of needed amendments for some crops. With the possible exception of the Lindsie and Huntington soils all are acid and need lime. All are well drained except the Briensburg, Collins, Lindsie, and Hymon soils, which have slow external and internal drainage; but their physical properties are such that they retain moisture well, thereby tending to insure an even and adequate supply for plant growth. Good tilth is easily maintained, and the range in moisture conditions for tillage is comparatively wide, though it is narrower in the imperfectly drained soils. Compared with the other soils, those of this class are relatively well supplied with organic matter. The physical properties favor normal circulation of air and moisture; and roots penetrate all parts of the subsoil freely, though air and moisture movements are restricted to some extent in the imperfectly drained soils. None of the soils is characterized by any prominent adverse soil condition. They are almost free from stones, their relief is favorable to soil conservation and tillage, and none is severely eroded or highly erodible.

The natural productivity of these soils is medium to relatively high. They are easily tilled, and the problem of conserving their fertility and material is relatively simple. All are well suited to most of the

exacting crops and intensive cropping practices under the prevailing systems of management.

The First-class soils are Huntington, Vicksburg, Wheeling, Briensburg, Collins, and Lindside silt loams; Huntington fine sandy loam; Wheeling very fine sandy loam; and Briensburg, Tigrett, Shannon, and Hymon loams. Their aggregate area is 39,552 acres, or 18.3 percent of the county.

SECOND-CLASS SOILS

Physically, Second-class soils constitute good to very good cropland under present farming practices. They have a greater diversity in physical characteristics than do the First-class soils. They are relatively similar in physical suitability for use in the agriculture but may differ in productivity, workability, and conservability within a limited range. Each is moderately deficient in one or more of these conditions, and the detrimental effect on their physical suitability for agricultural use is greater than for any of the First-class soils and less than for any of the Third-class soils. In general the Second-class soils are at least moderately productive of most crops grown in the county, and their physical properties are at least moderately favorable to tillage, maintenance of good tilth, and normal circulation and retention of moisture. None occupies very strong relief, and none is extremely stony or severely eroded. Internal drainage is slow to very slow in many of them. Each is moderately deficient in one or more desirable characteristics but not so deficient in any characteristic as to make it poorly suited physically to agricultural use.

The Second-class soils are Grenada silt loam, level phase; Memphis, Olivier, and Lexington silt loams, undulating phases; Scioto-ville very fine sandy loam; Scioto-ville, Olivier, Loring, Grenada, and Calloway silt loams; Egam and Lindside silty clay loams; and Scioto-ville and Wheeling silt loams, slope phases. They cover an aggregate area of 61,824 acres, or 28.7 percent of the county.

THIRD-CLASS SOILS

Physically, Third-class soils are poor to good cropland under prevailing farming practices. Each is characterized by one or more shortcomings in its workability, productivity, and conservability that make it less desirable than a Second-class soil for the production of the common cultivated crops when grown under prevailing farming practices. These shortcomings are not so great, however, as to make the soil definitely unsuited physically to cultivated crops. In these soils one or more of the following undesirable features is prominent: Low content of plant nutrients and organic matter, chertiness, droughtiness, erodibility, and slow internal drainage.

These soils are better suited physically to crop production under prevailing systems of management than Fourth-class soils but less well suited than Second-class soils. Their best use depends, among other things, on the other soils in the farm unit, the type of farm, and economic conditions.

The Third-class soils are Wheeling loamy fine sand; Dyer, Calhoun, Waverly, Melvin, Weinbach, Memphis, Providence, and Henry silt loams; Tigrett cherty loam; Brandon silt loam, undulating phase;

Beechy loam; Bodine loam, undulating phase; Loring, Lexington, and Brandon silt loams, rolling phases; and Iola gravelly loam. They cover an aggregate area of 53,440 acres, or 24.5 percent of the county.

FOURTH-CLASS SOILS

Physically, Fourth-class soils are poor to very poor cropland under prevailing farming practices but at least moderately productive of pasture plants. Each is so difficult to work or conserve, or both, that cultivation is generally infeasible; but a moderate cover of pasture plants can be maintained. In general, under the prevailing farm practices the soils of this class are best suited physically to pasture and are generally so used where enough fair to good cropland is available.

The Fourth-class soils are Melvin silty clay loam; Beechy loam, sanded phase; Memphis and Providence silt loams, hilly phases; Lexington, Brandon, and Carroll silt loams; and Lexington loam. Their aggregate area is 28,992 acres, or 13.5 percent of the county.

FIFTH-CLASS SOILS

Physically, Fifth-class soils are very poorly suited either to crops or to pasture under the prevailing farm practices. Each is so difficult to work or to conserve or both that cultivation is generally infeasible under the prevailing system of farming; and 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. Although forest trees may grow more slowly on most of these soils than on most of the soils of the four preceding classes, the Fifth-class soils are better suited physically to forest than to crops or pasture. Some farmers, however, who own little or none of the better classes have to use some of this land for pasture or even for crops.

Each soil of this class is characterized by one or more of the following undesirable features: Prevalingly hilly and steep relief, gravelly or cherty character, or severe erosion. In addition, most of them are low in content of available plant nutrients, are excessively drained, and are strongly to very strongly acid. As a result of these undesirable features, the natural productivity of both cultivated crops and pasture plants is generally low and tillage with common farm implements is either impossible or very difficult. If used for crops the requirements for conservation of these soils would be very exacting.

The Fifth-class soils are Lexington loam, steep phase; Bodine loam; Brandon silt loam, steep phase; Brandon gravelly loam; and Bodine cherty loam. Rough gullied land (Brandon soil material) and Gravel pit are nonarable miscellaneous land types that are included with this group of soils. The group has an aggregate area of 32,512 acres, or 15 percent of the county.

SOIL FERTILITY AND MANAGEMENT

The Kentucky Agricultural Experiment Station has made chemical analyses of important soils in the county in order to obtain information about their supply of plant nutrients. The results of these analyses are given in table 6. The total of nitrogen, phosphorus, and potassium—the three nutrients most likely to affect crop yields—and data on liming needs and soil reaction are given.

TABLE 6.—*Chemical analyses¹ of the more important soils in Marshall County, Ky.*

Soil type and sample No.	Approximate location	Depth	Nitrogen ²	Phosphorus ²	Potassium ²	CaCO ₃ ²	pH ³
		<i>Inches</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	
Grenada silt loam:							
5 ⁴	0.6 mile southeast of Jackson School.	0-7	1,980	840	27,400	720	4.8
		7-18	1,080	720	29,000	1,540	4.7
6.....	200 feet west of the location of sample No. 5.....	0-7	1,780	800	25,800	280	4.8
		7-18	860	780	28,400	1,700	4.8
24.....	1.3 miles northwest of Briensburg.	0-7	1,800	920	23,000	140	4.8
		7-18	1,000	840	25,600	3,320	4.6
27.....	0.5 mile north of Oakland Church.	0-7	1,380	760	25,800	440	4.8
		7-18	960	760	28,000	2,560	4.6
42.....	0.7 mile south of Oak Level School.	0-7	1,380	640	26,600	220	5.4
		7-18	980	640	29,800	1,880	4.9
Loring silt loam:							
4.....	0.4 mile south of Jonestown.....	0-7	1,360	700	26,000	440	4.7
		7-18	920	720	28,800	3,140	4.7
44.....	2 miles east of Oak Level School.....	0-7	1,400	660	28,400	80	6.4
		7-18	900	600	30,200	1,980	5.0
Calloway silt loam:							
1 ⁴	0.6 mile northeast of New Bethel Church.	0-7	2,260	880	21,400	1,460	4.9
		7-18	940	720	23,800	3,580	4.6
38.....	1 mile east of Rose Crossroads.....	0-7	1,620	1,000	19,400	1,340	4.8
		7-18	900	640	21,400	3,200	4.6
Henry silt loam:							
7 ⁴	0.7 mile southeast of Jackson School.	0-7	2,020	500	20,600	3,080	4.7
		7-18	760	300	23,200	9,580	4.5
Memphis silt loam:							
25.....	0.5 mile south of Calvert City School.	0-7	1,460	560	30,400	620	4.8
		7-18	1,020	560	32,400	3,420	4.6
Providence silt loam:							
8 ⁴	0.8 mile southeast of Oak Level School.	0-7	1,940	500	25,800	1,220	5.0
		7-18	1,000	480	27,200	4,540	4.6
20.....	0.3 mile east of Maple Spring School.	0-7	1,840	760	27,200	460	5.3
		7-18	840	600	27,000	3,800	4.8
23.....	1 mile east of Palma.....	0-7	1,560	720	29,000	1,520	4.6
		7-18	920	580	29,600	3,920	4.6
Lexington silt loam:							
22.....	0.9 mile south of Pugh School.....	0-7	1,300	680	29,600	1,280	4.6
		7-18	840	560	30,800	1,580	4.8
37 ⁴	0.3 mile east of Joppa School.....	0-7	1,780	740	26,800	80	5.7
		7-18	1,040	720	28,600	1,000	5.0
Brandon silt loam:							
19 ⁴	1.3 miles south of Maple Spring School.	0-7	1,400	600	29,800	1,540	4.6
		7-18	1,000	600	32,600	3,200	4.7
30.....	1 mile southeast of Sharpe School.	0-7	1,700	800	28,800	180	5.0
		7-18	1,080	560	29,400	1,900	4.6
43.....	0.8 mile east of Oak Level School.	0-7	1,200	620	27,000	360	4.9
		7-18	920	560	28,600	2,080	4.8
Olivier silt loam:							
32.....	1.3 miles northeast of Elva.....	0-7	1,960	1,160	29,800	100	5.4
		7-18	1,020	1,200	32,800	2,060	4.8
33.....	0.2 mile northwest of the intersection of the N. C. & St. L. Ry. and State highway 98.	0-7	1,660	720	23,000	400	4.8
		7-18	1,160	740	25,600	2,560	4.6
Calhoun silt loam:							
10 ⁴	0.5 mile north of intersection of the N. C. & St. L. Ry. and State highway 98.	0-7	1,660	840	21,600	3,860	4.6
		7-18	1,160	680	22,400	4,280	4.4
10a.....	100 feet south of the location of sample No 10.	0-7	1,340	880	20,800	1,980	4.6
		7-18	760	760	23,000	3,960	4.6
31.....	1.2 miles northeast of Elva.....	0-7	1,660	1,080	29,800	1,400	4.6
		7-18	860	1,480	30,600	4,140	4.5
Wheeling very fine sandy loam:							
9.....	1.2 miles northwest of Plainview School.	0-7	1,200	1,040	28,800	40	6.0
		7-18	840	1,200	32,000	760	5.5
13.....	1.6 miles northeast of Calvert City School.	0-7	1,200	1,240	23,800	80	6.2
		7-18	880	1,220	28,800	100	5.6
Scotoville silt loam:							
17.....	1.1 miles northwest of depot in Gilbertsville.	0-7	1,620	1,160	28,000	720	4.8
		7-18	1,060	1,200	29,600	1,940	4.7
26.....	0.4 mile southwest of Sanders Ridge School.	0-7	1,880	1,400	30,000	100	5.0
		7-18	1,100	1,400	34,800	2,600	4.6

See footnotes at end of table.

TABLE 6.—*Chemical analyses¹ of the more important soils in Marshall County, Ky.—Continued*

Soil type and sample No.	Approximate location	Depth	Nitrogen ²	Phosphorus ²	Potassium ²	CaCO ₃ ³	pH ⁴
		<i>Inches</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	
Weinbach silt loam:							
16 ⁵	0.1 mile south of Johnson Crossing.	0-7	1,660	1,800	30,600	6,260	4.6
		7-18	1,020	1,200	19,200	5,420	4.4
15a.....	250 feet west of the location of sample No. 15.	0-7	1,900	1,760	28,400	1,260	4.8
		7-18	960	1,320	30,000	4,240	4.6
18.....	1.5 miles northwest of depot in Gilbertsville.	0-7	1,660	1,520	28,400	540	4.8
		7-18	940	1,440	31,400	2,120	4.5
Shannon loam:							
2.....	1.7 miles north of Jackson School.	0-7	2,380	600	21,000	280	4.8
		7-18	1,180	560	21,200	280	5.0
Vicksburg silt loam:							
11.....	0.6 mile north of Iola.....	0-7	1,560	840	27,000	500	4.8
		7-18	1,400	860	26,600	1,540	4.7
34.....	0.3 mile southeast of Hardin School.	0-7	2,160	960	15,200	260	4.8
		7-18	1,640	840	15,200	140	4.8
40.....	0.2 mile west of Hale Spring....	0-7	1,500	680	24,600	760	4.6
		7-18	920	720	24,800	1,080	4.6
Collins silt loam:							
12.....	0.3 mile north of Iola.....	0-7	2,360	1,180	29,000	1,260	4.7
		7-18	1,640	1,160	28,200	2,480	4.6
41.....	0.2 mile northwest of Hale Spring.	0-7	1,880	740	24,800	1,540	4.6
		7-18	920	680	25,000	1,880	4.7
46.....	0.7 mile northeast of Sharpe School.	0-7	1,660	760	27,200	460	4.8
		7-18	1,580	720	26,200	1,400	4.6
Hymon loam							
21.....	0.3 mile east of Tatumsville....	0-7	1,490	800	22,600	360	5.2
		7-18	1,400	760	22,800	1,080	4.6
29.....	1.3 miles southeast of McCain School	0-7	1,260	760	23,800	80	4.9
		7-18	1,160	560	23,600	80	4.8
39.....	0.6 mile west of Hale Spring....	0-7	1,600	720	26,200	280	4.9
		7-18	1,620	820	26,400	800	4.7
Waverly silt loam:							
35.....	0.5 mile east of the intersection of the N. C. & St. L. Ry and State highway 98 at Hardin.	0-7	1,820	680	25,600	180	4.8
		7-18	1,840	860	25,000	280	4.8
36 ⁵	1.3 miles northeast of Brezeel School	0-7	2,780	1,040	25,400	760	4.6
		7-18	1,980	840	23,200	1,720	4.6
47.....	0.3 mile west of Oak Hill School.	0-7	1,640	720	30,200	80	5.6
		7-18	1,560	800	29,600	140	5.4
Beechy loam:							
28.....	1.3 miles southeast of Gregg School	0-7	1,740	660	21,200	80	5.8
		7-18	1,320	680	21,400	80	5.5
45.....	3.1 miles south of Calvert City School.	0-7	1,440	680	24,000	640	4.9
		7-18	1,120	680	23,800	1,260	4.8
Egam silty clay loam							
14.....	0.4 mile west of Sanders Ridge School	0-7	3,400	2,920	34,400	80	5.8
		7-18	3,580	2,640	35,200	100	5.8
16.....	0.1 mile west of Gilbertsville Ferry	0-7	2,860	2,580	33,200	80	6.0
		7-18	2,980	2,360	35,600	140	5.6

¹ Analyses by O. M. Shedd, Chemistry Department, Kentucky Agricultural Experiment Station.

² Quantity per 2,000,000 pounds of dry soil.

³ Amounts of CaCO₃ required to neutralize soil acidity determined by the Hopkins method.

⁴ pH values determined colorimetrically.

⁵ Sample taken in a wooded area

The analyses show that in the plow layer most of the soils contain about 1,200 to 2,000 pounds of nitrogen, 500 to 1,100 pounds of phosphorus, and 20,000 to 27,000 pounds of potassium and are moderately to strongly acid. In general the soils of the Tennessee River bottoms and terraces are highest in nutrients and less acid. The gray soils of the uplands and terraces, except Weinbach silt loam, which is on terraces of the Tennessee River, are generally lowest in potassium.

The total quantities of nutrients in soils are not necessarily closely related to crop yields, but a knowledge of these quantities can be of value in planning soil management systems. Kentucky soils that are naturally highly productive contain in the plow layer more than 3,000

pounds of nitrogen, 2,000 pounds of phosphorus, and 25,000 pounds of potassium. Compared with these quantities, the nitrogen and phosphorus content of most soils in Marshall County is relatively low, but their potassium content is about the same.

Building up and maintaining the soil supplies of organic matter and nitrogen is one of the most important problems of soil fertility in this county. Erosion has greatly lowered the quantities of organic matter and nitrogen in many of the soils and, because of the mild winters in this area, leaching also has removed considerable nitrogen from unprotected soils. Some of the nitrogen required by crops may be supplied profitably in fertilizers, but for building up and maintaining an adequate supply of nitrogen and organic matter in soils of the uplands and terraces used for cultivation they should be kept in legume or mixed legume-grass crops at least a third of the time. When drainage conditions permit, soils of the bottom lands also should be in these soil-improving crops part of the time.

Crop residues and farm manure should be conserved and returned to the soils, and the soils should be protected with a growing crop as much of the year as possible (16). Wheat, rye, or barley should be seeded on all cultivated land for a winter cover. Hairy vetch or crimson clover may be seeded with the small grain.

The low phosphorus content of the soils should be supplemented by liberal phosphorus fertilization. The equivalent of 20 pounds of phosphoric acid (P_2O_5) per acre each year should be applied to most of the cropland. Unless all crop residues and farm manures are conserved and returned to the soil, potassium fertilization will be necessary for good yields of many crops—in particular, tobacco, alfalfa, corn, cotton, and perhaps strawberries. The Calloway, Henry, and other poorly drained gray soils are especially likely to need potassium fertilization.

The pH values (table 6) are expressions of acidity or alkalinity. Strict neutrality is indicated by the symbol pH 7.0; values of less than 7.0 indicate acidity, and the lower the value the more acid the soil. For general cropping, sufficient lime should be applied to soils to keep the pH above 6.0 and for the more lime-loving crops like alfalfa, above 6.5. Soils with values below pH 5.0 are very strongly acid (9), and most crops grow poorly on them. The quantities of calcium carbonate (chemically pure ground limestone) required to neutralize soil acidity as found by the Hopkins method are only suggestive of the quantities to be used in the field. Usually it pays when liming land to add enough to last for several years. The quantity also varies with the crops to be grown. Field tests are the best way to determine the proper liming rate. In general, most of the soils in the county, when legumes are to be grown in the rotation, should receive 2 to 3 tons an acre of ground limestone as an initial application and perhaps 1 to 2 tons every 8 to 12 years thereafter.

Liming and the application of phosphate to most of the soils are basic practices in maintaining the soil supply of nitrogen and organic matter because they are necessary for the successful growth of the soil improving crops. Proper land use, contour tillage, and the use of terraces to prevent soil erosion on sloping croplands also are essential in building up and maintaining soil productivity.

In 1913 the Kentucky Agricultural Experiment Station established an experiment field near Mayfield in Graves County, which adjoins Marshall County on the west. The soil of this field is principally Grenada silt loam and its level phase. A 4-year rotation of corn, a small-grain cover crop, soybeans, wheat, and red clover has been used on four series of plots. A 6-year rotation of fire-cured tobacco, small-grain cover crop, tobacco, wheat, and clover and grass for 3 years was started in 1929 on another series of plots. The response of the crops in these rotations to soil applications of ground limestone and various fertilizers is given in tables 7 and 8.⁹

The results of these experiments show that ground limestone was very effective in increasing the yields of all crops on these soils, except possibly tobacco. In the 4-year rotation, rock phosphate was more effective than superphosphate on the unlimed soils. Either was effective on limed soils, except for corn. The potash was not consistently effective, although it produced some increases in yields when used with ground limestone and superphosphate in the 4-year rotation and when used in a complete fertilizer for tobacco. Manure had been applied to the plots. Marked potash deficiency appeared in recent corn crops on comparable plots receiving the limestone-superphosphate treatment but no manure (17).

Crop yields per acre on the plots in the 4-year rotation receiving limestone and phosphate were approximately 50 bushels of corn, 20 bushels of wheat, and 1.8 tons each of soybean and mixed clover hay. Under good systems of soil management and fertilization in seasonal years yields this large should be obtained on all the First- and Second-class soils and yields can be considerably increased on most of the others.

TABLE 7.—Increase in acre yields on plots receiving limestone and fertilizers, in addition to manure, in the 4-year rotation on the Mayfield Soil Experiment Field, Graves County, Ky.¹

Treatment ²	Corn (average 23 crops)	Soybean hay (aver- age 16 crops)	Wheat (average 21 crops)	Mixed clover hay (average 19 crops) ³
	Bushels	Pounds	Bushels	Pounds
Ground limestone.....	10. 6	662	4. 7	1, 637
Superphosphate.....	2. 1	161	3. 5	733
Rock phosphate.....	6. 6	433	5. 4	1, 862
Ground limestone and super- phosphate ⁴	10. 4	908	10. 9	2, 750
Ground limestone and rock phos- phate.....	11. 7	944	10. 1	2, 698
Ground limestone, superphos- phate, and muriate of potash..	14. 0	999	13. 5	3, 316

¹ Data from Kentucky Agricultural Experiment Station Bul. 397 (18).

² Average acre yields on 4 plots receiving only manure: Corn (average 23 crops) 38 bushels, soybean hay (average 16 crops) 2,637 pounds, wheat (average 21 crops) 10 bushels, and mixed clover hay (average 19 crops) 1,891 pounds.

³ First-year hay.

⁴ Average acre yields on 2 plots.

⁹ Detailed procedure and results of these experiments may be found in Kentucky Agricultural Experiment Station Bulletins 379 and 397 (19, 18).

TABLE 8.—*Crop yields per acre from the various treatments in the tobacco rotation on the Mayfield Soil Experiment Field, Graves County, Ky.*¹

Treatment ²	Tobacco (average 7 crops)	Wheat (average 3 crops)	First-year hay (aver- age 5 years)	Second-year hay (aver- age 4 years)
	<i>Pounds</i>	<i>Bushels</i>	<i>Pounds</i>	<i>Pounds</i>
None.....	1, 109	15. 3	1, 384	2, 392
Superphosphate.....	1, 271	19. 4	2, 074	2, 884
Ground limestone and super- phosphate.....	1, 339	27. 0	3, 456	3, 596
Ground limestone, superphos- phate, and sulfate of potash.....	1, 273	25. 7	4, 259	3, 996
Ground limestone, superphos- phate, and nitrate of soda.....	1, 297	32. 5	3, 830	3, 196
Ground limestone, superphos- phate, sulfate of potash, and nitrate of soda.....	1, 460	32. 1	4, 198	3, 608

¹ Data from Kentucky Agricultural Experiment Station Bul. 379 (10).

² 5 to 6 tons per acre of manure has been applied to all plots

In 1934, the Kentucky Agricultural Experiment Station in cooperation with the Tennessee Valley Authority established an experiment field on a farm near Murray, in Calloway County (which adjoins Marshall County on the south), to study crop responses to various phosphates on limed and unlimed land. The plots were located mainly on Grenada silt loam, level phase. In a 3-year rotation of corn, wheat, and lespedeza there were very marked increases in the yields of all three crops from the use of a combination of ground limestone and superphosphate, whereas when either was used alone, the increases in the yields were considerably less.

SOIL MANAGEMENT GROUPS

Although each soil may have individual characteristics affecting its use suitability and management, the soils of the county may be combined into groups, the members of which are much alike in their management problems. For convenience these groups are referred to by number, from 1 to 13. Groups 1, 2, 3, 4, and 5 comprise the brown soils of the smoother uplands and stream terraces; groups 6 and 13, the gray soils of the uplands and stream terraces; groups 7 and 8, the soils of the rougher uplands; groups 9 and 10, the well-drained and imperfectly drained soils of the flood plains; groups 11 and 12, the poorly drained soils of the flood plains.

GROUP 1

Group 1 comprises Grenada silt loam and its level phase, Loring silt loam, Olivier silt loam and its undulating phase, and Bodine loam, undulating phase. These soils have slopes of 5 percent and less and are characterized by a somewhat heavy-textured and compact layer in the lower subsoil. They are well suited to the production of dark fire-cured tobacco and constitute the most extensive group of general-farming soils in the county.

An important step in preparing these soils for agricultural use is to correct their acidity. This can best be done by applying about 2 tons an acre of ground limestone immediately following the tobacco or strawberry crop and preceding other cultivated crops. For each rotation 300 to 400 pounds of 20-percent superphosphate or its equivalent should be used to meet the requirement for phosphate. The fertilization for alfalfa, however, should be 500 to 600 pounds of superphosphate and, unless barnyard manure has been applied, the equivalent of 100 to 200 pounds of muriate of potash.

A basic rotation for use when tobacco is grown includes a legume-grass mixture for 3 years; tobacco, followed by a winter cover crop of a small grain and crimson clover; tobacco; and wheat, with the legume-grass mixture reseeded in the wheat. An acre application of 200 to 300 pounds of a 3-8-6 fertilizer or its equivalent will probably prove economical for tobacco. When corn is grown, a good rotation is a legume-grass mixture for 2 years, corn, and wheat. When these soils are in a state of low productivity they should remain in the sod crop for a longer period if possible.

GROUP 2

Comprising group 2 are the undulating phases of Memphis, Lexington, and Brandon silt loams, which are the remaining brown soils of the uplands having slopes of 5 percent and less. They do not have a mottled-gray heavy-textured compact lower subsoil layer, as characterizes the soils of group 1, and are considered less well suited to the production of good grade dark fire-cured tobacco. A basic rotation suggested for these soils includes a mixture of legumes and grasses for at least 2 years; a cultivated crop, as corn or cotton; and wheat or some other small-grain crop. These soils require the same lime and fertilizer treatment as those of group 1. When they are in a poor state of productivity, it is advisable that as much of their acreage as possible be allowed to remain in sod crops for a longer time.

GROUP 3

Group 3 comprises Memphis and Providence silt loams and the rolling phases of Loring, Lexington, and Brandon silt loams. These soils have slopes of 5 to 10 percent but can be made fairly productive if erosion is controlled. Strict adherence to the erosion-control practices brought out in the section on Water Control on the Land is necessary in order to conserve these soils for crops or even for pasture. Because of their rather strong slopes they should be easier to conserve in most places if used for pasture than if used for cultivated crops.

If the soils of this group are needed for feed crops, a 1-year rotation of barley seeded to Korean lespedeza may prove feasible, provided the soils are in a fairly high state of productivity. The lespedeza should reseed itself, and the barley can be sown after disking. Most of the crops should be used for feed and the manure returned to the land. If intertilled crops are grown, they should be planted in a long rotation in which sod crops are on the land most of the time. These soils should have an application of 2 tons an acre of ground limestone. A treatment of 300 to 400 pounds of 20-percent superphosphate every 4 years should be all the fertilization required if the land is kept in hay

and pasture. If the 1-year rotation of barley and lespedeza proves satisfactory, an application of 150 pounds of 20-percent superphosphate annually will probably be needed. The severely gullied areas should be planted to trees.

GROUP 4

Group 4 consists of Wheeling silt loam and its slope phase, Wheeling very fine sandy loam and loamy fine sand, Sciotoville silt loam and its slope phase, and Sciotoville very fine sandy loam. These soils are on terraces of the Tennessee River and have good or fair drainage. They are probably best suited to a 4-year rotation consisting of corn or cotton; wheat; and for 2 years a mixture of legumes and grasses, as red clover and timothy. A longer rotation may be used in which strawberries supersede some cultivated crop for 2 or 3 years, followed by a grass-legume mixture for 4 or 5 years. It is probable that phosphate fertilizers will prove economical for many crops, and red clover and other legumes will probably make satisfactory growth if the land is treated with 1 to 1½ tons an acre of ground limestone.

GROUP 5

Group 5 consists of only one soil—Iola gravelly loam. It has a fairly low water-holding capacity and dries out rather readily. The best use for it is early truck crops, fall-sown grains, or other early-maturing crops. Cover crops should be grown where possible. Liberal applications of barnyard and green manures and possibly phosphate and potash should be made.

GROUP 6

Group 6 comprises Henry, Calloway, Calhoun, and Weinbach silt loams. These soils occupy nearly level positions or slight depressions on uplands or stream terraces. Henry, Calloway, and Calhoun silt loams are considered suited to crops, but they should receive somewhat heavier applications of ground limestone and phosphate than the other soils of the uplands. Moderate applications of potash may prove profitable. Weinbach silt loam will probably need about the same management as the Sciotoville soils in group 4, providing crop residues and manures are applied. If tobacco, cotton, or strawberries are grown, small quantities of potash may be added. These four soils are better suited to sorghum than to most of the other cultivated crops. A rotation probably best suited to them consists of sorghum or corn; wheat or other small grain; and a mixture of lespedeza, alsike clover, and redbottom for 2 years or longer.

GROUP 7

In group 7 are Lexington and Brandon silt loams, Lexington loam, and the hilly phases of Memphis and Providence silt loams. These soils have slopes of 10 to 18 percent and are too steep for cultivation but may be used for permanent pasture if erosion is controlled and other good management is practiced.

Unless these soils have recently been cleared, an application of 2 tons an acre of ground limestone and 150 to 200 pounds of 20-percent superphosphate will be needed for satisfactory pasture. A mixture

of grasses and legumes, as lespedeza, sweetclover, orchard grass, and redtop, should be seeded on these soils. Alfalfa, alsike, white, red, and hop clovers, yellow trefoil, and Canada bluegrass may be added to this pasture mixture. Gullied spots should be planted to black locust or pine trees and Bermuda grass or kudzu. Where erosion is severe, the best use may be forest, and where it is moderate, the best use might be pasture.

GROUP 8

Group 8 comprises the steep phases of Brandon silt loam and Lexington loam, Brandon gravelly loam, Bodine loam and cherty loam, Rough gullied land (Brandon soil material), and Gravel pit. These soils and land types are unsuited to crops and pasture, and their feasible use is for trees. Gravel pit, however, is worked for road-building material.

Bodine loam and the steep phases of Brandon silt loam and Lexington loam generally have slopes between 18 and 40 percent and are too steep for feasible use other than trees. Brandon gravelly loam and Bodine cherty loam contain many pieces of gravel or fragments of chert. They have very poor workability, conservability, and productivity and are unsuitable for crops and pasture. Rough gullied land (Brandon soil material) is too severely eroded to be used either for crops or pasture; however, black locust and pine trees have grown well on many of the gullied areas.

GROUP 9

The soils of group 9 are Huntington silt loam and fine sandy loam, Egam silty clay loam, Vicksburg and Collins silt loams, Shannon and Hymon loams, and Lindside silt loam and silty clay loam. The Huntington, Egam, Vicksburg, and Shannon soils are well drained and the Lindside, Collins, and Hymon soils imperfectly drained. All are subject to flooding by the adjacent streams.

In the management of Vicksburg and Collins silt loams and Shannon and Hymon loams, 200 to 250 pounds an acre of 20-percent superphosphate or its equivalent should be applied when these soils are used for a 2-year rotation of corn and barley, with sweetclover seeded in the barley and turned under about 2 weeks before corn is planted. If sweetclover is grown, the land should receive an application of 1½ to 2 tons an acre of ground limestone. If the barley is killed by overflow from the streams, spring oats may be sown on the land and sweetclover sown in the oats. A 3-year rotation of corn, corn, and sweetclover with a cover crop each winter also is suitable. In the management of Huntington and Lindside silt loams, Egam and Lindside silty clay loams, and Huntington fine sandy loam no lime or phosphate should be needed for the crops commonly grown on them.

GROUP 10

Group 10 comprises Tigrett loam and cherty loam and Briensburg loam and silt loam. These soils are at elevations above the usual overflow of adjacent streams. About the same treatment with ground limestone and phosphate as is given the Grenada and other soils of the uplands should be given these soils. They are suitable for a 4-year

rotation that includes a cultivated crop, wheat, and a mixture of legumes and grasses for 2 years, or a 4-year rotation consisting of corn, corn, wheat, and sweetclover sown in the wheat. A longer rotation also is suitable, in which strawberries follow a cultivated crop for 2 or 3 years and are superseded by a legume-grass mixture for 4 or 5 years. In some areas where Tigrett cherty loam has a rather low water-holding capacity and dries out fairly readily, early-maturing crops are probably best suited.

GROUP 11

Dyer silt loam, the only soil in group 11, is the only poorly drained soil of the bottom lands that lies above the usual overflow of the streams. The most suitable management for it is probably the same as for Tigrett and Briensburg loams and Briensburg silt loam in group 10. When tobacco and strawberries are grown, however, a potash fertilizer should prove profitable. This soil should also receive a heavier application of ground limestone than soils in group 10 and should be adequately drained.

GROUP 12

Waverly and Melvin silt loams, Beechy loam and its sanded phase, and Melvin silty clay loam are in group 12. When Waverly and Melvin silt loams and Beechy loam have been artificially drained, as they should be where possible, they should lend themselves to the same management as given the soils of group 9, except that they should receive heavier applications of ground limestone. In artificially drained areas a 3-year rotation of corn, wheat, and a mixture of redtop and lespedeza would be better than a 2-year rotation. Melvin silty clay loam and Beechy loam, sanded phase, are considered best suited to permanent pasture, and a mixture of reed canary grass, redtop, and Kobe lespedeza is suggested. It is doubtful that the use of lime and phosphate would be profitable on these two soils.

GROUP 13

Group 13 consists of only one soil—Carroll silt loam. Its heavy-textured subsoil at a comparatively shallow depth and its very poor drainage make forest its most feasible use, though some areas are used for hay.

ESTIMATED YIELDS AND PRODUCTIVITY RATINGS

The soils of Marshall County are listed alphabetically in table 9, and for each the estimated average acre yields of the principal crops under two levels of management are given.

TABLE 9.—Expected average acre yields of the principal crops under 2 levels of management and the workability and conservability of the soils of Marshall County, Ky.

[Estimated yields in columns B are those to be expected under common management practices; those in columns C are to be expected under good management practices.]

Soil 1	Corn		Wheat		Lespedeza hay		Redtop hay		Soybean hay		Cotton (lint)		Tobacco (dark fire-cured)		Strawberries		Permanent pasture		Workability 2	Conservability 3	
	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C			
Beechy loam.....	Bu. 20	Bu. 35	Bu. 9	Bu. 9	Tons 0.7	Tons 1.4	Tons 0.9	Tons 1.1	Tons 1.1	Tons 1.5	Lb. 0	Lb. 500	Lb. 700	Lb. 20	Lb. 55	24- quart crates 35	24- quart crates 55	Cow- acre- days 55	Cow- acre- days 55	Fair.....	Good.
Sanded phase.....	(9) 20	(9) 20	(9) 9	(9) 9	(9) 1.0	(9) 1.0	(9) 0.9	(9) 1.0	(9) 1.2	(9) 1.2	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	Poor.....	Do.
Bodine cherty loam.....	(9) 20	(9) 20	(9) 9	(9) 9	(9) 0.8	(9) 0.8	(9) 0.8	(9) 0.8	(9) 0.8	(9) 0.8	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	Very poor.....	Very poor.
Bodine loam.....	(9) 20	(9) 30	(9) 10	(9) 13	(9) 0.6	(9) 1.1	(9) 0.5	(9) 0.8	(9) 0.8	(9) 1.3	(9) 200	(9) 300	(9) 650	(9) 800	(9) 48	(9) 60	(9) 35	(9) 60	(9) 60	Fair.....	Fair
Undulating phase.....	20	30	10	13	0.6	1.1	0.5	0.8	0.8	1.3	200	300	650	800	48	60	35	60	60	Fair.....	Fair
Brandon gravelly loam.....	(9) 7	(9) 18	(9) 3	(9) 8	(9) 0.2	(9) 0.7	(9) 0.2	(9) 0.4	(9) 0.4	(9) 0.7	(9) 80	(9) 160	(9) 350	(9) 500	(9) 15	(9) 30	(9) 10	(9) 30	(9) 30	Very poor.....	Very poor.
Brandon silt loam.....	(9) 7	(9) 18	(9) 3	(9) 8	(9) 0.2	(9) 0.7	(9) 0.2	(9) 0.4	(9) 0.4	(9) 0.7	(9) 80	(9) 160	(9) 350	(9) 500	(9) 15	(9) 30	(9) 10	(9) 30	(9) 30	Poor.....	Poor.
Rolling phase.....	12	24	8	11	0.4	0.9	0.3	0.6	0.6	1.0	170	252	500	650	40	50	20	45	45	Fair.....	Fair.
Steep phase.....	(9) 7	(9) 15	(9) 3	(9) 8	(9) 0.2	(9) 0.7	(9) 0.2	(9) 0.4	(9) 0.4	(9) 0.7	(9) 80	(9) 160	(9) 350	(9) 500	(9) 15	(9) 30	(9) 10	(9) 30	(9) 30	Very poor.....	Very poor.
Undulating phase.....	20	30	10	13	0.6	1.1	0.5	0.8	0.8	1.3	230	320	625	750	55	65	30	55	55	Good.....	Fair.
Briensburg loam.....	33	50	13	17	1.0	1.8	1.0	1.3	1.4	2.0	230	440	825	925	90	115	55	80	80	Very good.....	Very good
Briensburg silt loam.....	38	50	14	18	1.1	1.8	1.1	1.3	1.5	2.0	240	440	850	950	95	120	60	85	85	do.....	Do.
Calhoun silt loam.....	19	30	7	12	0.8	1.4	0.8	1.1	1.0	1.6	(9) 0	(9) 750	(9) 925	(9) 55	(9) 70	(9) 35	(9) 60	(9) 60	(9) 60	Fair.....	Good.
Calloway silt loam.....	20	30	8	12	0.8	1.4	0.8	1.1	1.0	1.6	(9) 0	(9) 775	(9) 925	(9) 55	(9) 70	(9) 35	(9) 60	(9) 60	(9) 60	do.....	Do.
Carroll silt loam.....	7	15	(9) 3	(9) 8	(9) 0.4	(9) 0.8	(9) 0.4	(9) 0.7	(9) 0.7	1.0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 20	(9) 40	(9) 20	(9) 45	(9) 45	do.....	Do.
Collins silt loam.....	34	50	6	12	1.0	1.7	1.0	1.3	1.5	2.0	(9) 0	(9) 700	(9) 825	(9) 70	(9) 85	(9) 55	(9) 85	(9) 85	(9) 85	Very good.....	Very good.
Dyer silt loam.....	25	40	9	12	1.0	1.6	1.0	1.2	1.2	1.6	(9) 0	(9) 750	(9) 925	(9) 60	(9) 75	(9) 40	(9) 65	(9) 65	(9) 65	Fair.....	Good.
Egam silty clay loam.....	25	40	(9) 9	(9) 15	(9) 0.8	(9) 1.5	(9) 0.8	(9) 1.0	(9) 1.5	1.7	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	do.....	do.
Gravel pit.....	(9) 24	(9) 35	(9) 10	(9) 13	(9) 0.7	(9) 1.3	(9) 0.6	(9) 0.9	(9) 0.9	1.5	(9) 200	(9) 300	(9) 800	(9) 1,100	(9) 60	(9) 70	(9) 35	(9) 60	(9) 60	Very poor.....	Very poor.
Grenada silt loam.....	26	38	11	14	0.8	1.4	0.7	1.0	1.0	1.6	220	340	900	1,000	65	75	40	65	65	Good.....	Fair.
Level phase.....	24	35	10	13	0.7	1.3	0.6	0.9	0.9	1.5	200	300	800	1,100	60	70	35	60	60	Good.....	Fair.
Henry silt loam.....	12	20	(9) 9	(9) 10	(9) 0.6	(9) 1.0	(9) 0.5	(9) 0.9	(9) 0.8	1.3	(9) 0	(9) 650	(9) 800	(9) 30	(9) 60	(9) 25	(9) 50	(9) 50	(9) 50	Fair.....	Good.
Huntington fine sandy loam.....	38	50	(9) 9	(9) 12	(9) 1.2	(9) 1.7	(9) 1.0	(9) 1.3	(9) 1.9	2.0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	do.....	Do.
Huntington silt loam.....	40	55	(9) 9	(9) 13	(9) 1.3	(9) 1.8	(9) 1.1	(9) 1.3	(9) 2.0	2.2	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	do.....	do.
Hymon loam.....	32	45	5	11	1.0	1.7	1.0	1.3	1.4	1.8	(9) 0	(9) 675	(9) 800	(9) 65	(9) 80	(9) 55	(9) 85	(9) 85	(9) 85	Very good.....	Very good.
Iola gravelly loam.....	12	20	5	11	0.3	0.7	0.2	0.4	0.5	0.8	120	260	(9) 0	(9) 30	(9) 50	(9) 10	(9) 30	(9) 30	(9) 30	Fair.....	Fair.
Lexington loam.....	9	20	3	9	0.3	0.8	0.2	0.5	0.5	0.8	100	200	375	525	20	35	15	40	40	Poor.....	Poor.
Steep phase.....	(9) 9	(9) 20	(9) 3	(9) 9	(9) 0.3	(9) 0.8	(9) 0.2	(9) 0.5	(9) 0.5	(9) 0.8	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	(9) 0	Very poor.....	Very poor.
Lexington silt loam.....	9	20	3	9	0.3	0.8	0.2	0.5	0.5	0.8	100	200	375	550	20	35	15	40	40	Poor.....	Poor.
Rolling phase.....	14	27	9	12	0.5	1.0	0.4	0.7	0.7	1.1	180	280	550	675	45	55	25	50	50	Fair.....	Fair.
Undulating phase.....	25	40	13	16	0.8	1.5	0.6	1.0	1.1	1.7	260	380	725	850	45	75	40	65	65	Good.....	Do.

Lindside silt loam.....	34	45	(9)	(9)	1.3	1.8	1.1	1.3	1.5	2.0	(9)	(9)	(9)	(9)	(9)	(9)	65	90	Very good...	Very good.
Lindside silty clay loam.....	25	40	(9)	(9)	.8	1.4	.8	1.0	1.5	1.7	(9)	(9)	(9)	(9)	(9)	(9)	60	75	Fair.....	Do.
Loring silt loam.....	27	39	12	15	.8	1.4	.5	.9	1.0	1.6	240	360	775	950	65	75	35	60	Very good...	Fair.
Rolling phase.....	19	27	8	11	.5	1.0	.3	.6	.7	1.1	170	252	575	700	45	55	25	50	Fair.....	Do.
Melvin silt loam.....	22	40	(9)	(9)	.8	1.5	1.0	1.2	1.2	1.6	(9)	(9)	(9)	(9)	(9)	(9)	30	50	do.....	Good.
Melvin silty clay loam.....	15	35	(9)	(9)	.6	1.2	.8	1.0	1.2	1.5	(9)	(9)	(9)	(9)	(9)	(9)	30	50	Poor.....	Do.
Memphis silt loam.....	20	30	9	12	.6	1.1	.4	.7	.8	1.2	180	280	575	700	48	60	30	55	Fair.....	Fair.
Hilly phase.....	9	20	4	10	.3	.9	.2	.6	.6	.9	100	200	375	550	20	40	20	45	Poor.....	Poor.
Undulating phase.....	28	42	13	16	.8	1.5	.6	1.0	1.1	1.7	270	400	750	900	70	80	40	65	Very good...	Fair.
Olivier silt loam.....	26	38	11	14	.8	1.4	.6	1.0	1.0	1.6	210	340	900	1,000	65	75	40	65	do.....	Good.
Undulating phase.....	24	35	10	13	.7	1.3	.5	.9	.9	1.5	200	300	800	950	60	70	35	60	Good.....	Fair.
Providence silt loam.....	18	26	8	11	.5	1.0	.3	.6	.7	1.1	170	250	575	700	45	55	25	50	Fair.....	Do.
Hilly phase.....	9	20	3	9	.3	.8	.2	.5	.5	.8	80	160	400	550	20	35	15	40	Poor.....	Poor.
Rough gullied land (Brandon soil material).....	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	(9)	Very poor..	Very poor.
Sciotoville silt loam.....	26	40	14	18	.9	1.5	.7	1.1	1.2	1.8	320	440	800	950	70	85	45	70	Very good...	Good.
Slope phase.....	22	38	12	16	.8	1.4	.6	1.0	1.1	1.7	270	380	700	825	65	80	40	65	Good.....	Fair.
Sciotoville very fine sandy loam.....	26	40	14	18	.9	1.5	.7	1.1	1.2	1.8	350	480	(9)	(9)	70	85	45	70	Very good...	Good.
Shannon loam.....	35	45	8	14	1.0	1.7	1.0	1.3	1.4	1.8	200	360	725	900	70	85	55	80	Excellent...	Very good.
Tigrett cherty loam.....	20	30	7	13	.6	1.0	.7	.9	1.0	1.3	180	320	600	725	45	65	40	60	Fair.....	Do.
Tigrett loam.....	34	45	14	17	1.0	1.7	1.0	1.3	1.4	1.8	280	520	800	925	85	90	80	85	do.....	Excellent.
Vicksburg silt loam.....	38	50	8	14	1.0	1.7	1.0	1.3	1.5	2.0	200	360	750	850	75	90	60	80	Fair.....	Good.
Waverly silt loam.....	22	40	3	10	.8	1.5	1.0	1.2	1.2	1.6	(9)	(9)	550	750	25	60	40	60	do.....	Do.
Weinbach silt loam.....	15	30	4	11	.7	1.2	.6	1.0	1.0	1.6	(9)	(9)	650	800	50	70	35	60	do.....	Do.
Wheeling loamy fine sand.....	25	34	10	15	.6	1.1	.6	.9	1.0	1.5	300	400	(9)	(9)	38	65	35	60	Excellent...	Fair.
Wheeling silt loam.....	31	45	16	20	1.0	1.8	.8	1.2	1.4	2.0	350	520	800	950	75	90	65	80	do.....	Very good.
Slope phase.....	21	32	11	13	.7	1.2	.6	.9	1.0	1.6	240	360	(9)	(9)	53	65	35	60	Fair.....	Fair.
Wheeling very fine sandy loam.....	31	45	16	20	1.0	1.8	.8	1.2	1.4	2.0	400	540	(9)	(9)	75	90	65	80	Excellent...	Very good.

¹ Soils are listed in alphabetical order.

² Workability refers to the ease of tillage, harvesting, and other field operations.

³ Conservability refers to the ease with which productivity and workability can be maintained or improved; it includes as major considerations ease of conservation of soil material, of conservation of plant nutrients, and of maintenance of good tilth.

⁴ Cow-acre-days, used to express the carrying capacity of pasture land, is the product of

the number of animal units carried per acre multiplied by the number of days that animals can be grazed without injury to pasture; for example, a soil that supports 1 animal unit per acre for 360 days rates 360; a soil supporting 1 animal unit on 2 acres for 180 days rates 90; and a soil supporting 1 animal unit on 4 acres for 100 days rates 25.

⁵ Amendments rarely applied.

⁶ Crop commonly not grown.

TABLE 10.—*Productivity ratings of the soils under 2 levels of management for the crops most commonly grown, physical land classification,¹ and principal use of the soils of Marshall County, Ky.*

[Indexes in columns B are the yields obtained under common management practices; those in columns C are the yields that may be expected under good management practices.]

FIRST-CLASS SOILS
VERY GOOD TO EXCELLENT CROPLAND

Soils ²	Crop productivity index ³ for—																Principal use		
	Corn (100=50 bushels)		Wheat (100=25 bushels)		Lespedeza hay (100=1½ tons)		Redtop hay (100=1½ tons)		Soybean hay (100=2½ tons)		Cotton (lint) (100=400 pounds)		Tobacco (dark fire-cured) (100=1,000 pounds)		Strawberries (100=100 24-quart crates)			Permanent pasture (100=100 cow-acre- days) ⁴	
	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C		B	C
Huntington silt loam.....	80	110	(⁵)	(⁵)	85	120	75	85	80	90	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	65	90	Crops (corn).
Huntington fine sandy loam..	75	100	(⁵)	(⁵)	80	115	65	85	75	80	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	60	85	Do.
Vicksburg silt loam.....	75	100	30	55	65	115	65	85	60	80	50	75	85	75	90	60	85	85	Do.
Wheeling very fine sandy loam.....	60	90	65	80	65	120	55	80	55	80	100	135	(⁵)	(⁵)	75	90	55	80	Crops (corn, wheat, hay).
Wheeling silt loam.....	60	90	65	80	65	120	55	80	55	80	90	130	80	95	75	90	55	80	Do.
Briensburg silt loam.....	75	100	55	70	75	120	75	85	60	80	60	110	85	95	95	120	60	85	Crops (corn, hay).
Briensburg loam.....	65	100	55	70	65	120	65	85	55	80	60	110	85	95	90	115	55	80	Do.
Tigrett loam.....	70	90	55	70	65	115	65	85	55	70	70	130	80	95	85	90	55	80	Do.
Shannon loam.....	70	90	30	55	65	115	65	85	55	70	50	90	75	90	70	85	55	80	Crops (corn).
Collins silt loam.....	70	100	25	50	65	115	65	85	60	80	(⁵)	(⁵)	70	85	70	85	55	85	Do.
Lindside silt loam.....	70	90	(⁵)	(⁵)	85	120	75	85	60	80	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	65	90	Forest; crops (corn).
Hymon loam.....	65	90	20	45	65	115	65	85	55	70	(⁵)	(⁵)	70	80	65	80	55	85	Crops (corn).

SECOND-CLASS SOILS
GOOD TO VERY GOOD CROPLAND

Grenada silt loam, level phase.	50	75	45	55	55	95	45	65	40	65	55	75	90	100	65	75	40	65	Crops (corn, hay, tobacco).
Olivier silt loam	50	75	45	55	55	95	40	65	40	65	55	75	90	100	65	75	40	65	Do.
Sciotoville very fine sandy loam.	50	80	55	70	60	100	45	75	50	70	90	120	(⁶)	(⁶)	70	85	45	70	Crops (corn, wheat, hay).
Sciotoville silt loam	50	80	55	70	60	100	45	75	50	70	80	110	80	95	70	85	45	70	Do.
Memphis silt loam, undulating phase.	55	85	50	65	55	100	40	65	45	70	70	100	75	90	70	80	40	65	Crops (hay, corn, tobacco); idle land.
Loring silt loam	55	80	50	60	55	95	35	60	40	65	60	90	80	95	65	75	35	60	Do.
Egam silty clay loam	50	80	(⁶)	(⁶)	60	100	55	65	60	70	(⁶)	(^{6})	(^{6})	(^{6})	(^{6})	(^{6})	50	75	Crops (corn).
Lindside silty clay loam	50	80	(⁶)	(⁶)	55	95	55	65	60	70	(⁶)	(^{6})	(^{6})	(^{6})	(^{6})	(^{6})	50	75	Do.
Lexington silt loam, undulating phase.	50	80	50	65	55	100	40	65	45	70	65	95	75	85	45	75	40	65	Idle land; crops (hay, corn, tobacco).
Grenada silt loam	50	70	40	50	45	85	40	60	35	60	50	75	80	110	60	70	35	60	Crops (corn, hay, tobacco); idle land.
Olivier silt loam, undulating phase.	50	70	40	50	45	85	35	60	35	60	50	75	80	95	60	70	35	60	Do.
Sciotoville silt loam, slope phase.	45	75	50	65	55	95	40	65	45	70	70	95	70	85	65	80	40	65	Crops (corn); idle land.
Wheeling silt loam, slope phase.	40	65	45	50	50	80	40	60	40	65	60	90	(⁶)	(⁶)	55	65	35	60	Crops (corn, wheat); forest.
Calloway silt loam	40	60	30	50	55	95	55	75	40	65	(⁶)	(⁶)	80	95	55	70	35	60	Crops (corn, hay); forest.

See footnotes at end of table.

TABLE 10.—*Productivity ratings of the soils under 2 levels of management for the crops most commonly grown, physical land classification,¹ and principal use of the soils of Marshall County, Ky.—Continued*

THIRD-CLASS SOILS

POOR TO GOOD CROPLAND

Soils ²	Crop productivity index ³ for—																Principal use		
	Corn (100=50 bushels)		Wheat (100=25 bushels)		Lespedeza hay (100=1½ tons)		Redtop hay (100=1½ tons)		Soybean hay (100=2½ tons)		Cotton (lint) (100=400 pounds)		Tobacco (dark fire-cured) (100=1,000 pounds)		Strawberries (100=100 24-quart crates)			Permanent pasture (100=100 cow-acre- days) ⁴	
	B	C	B	C	B	C	B	C	B	C	B	C	B	C	B	C		B	C
Wheeling loamy fine sand.....	50	70	40	60	40	75	40	60	40	60	75	100	(⁵)	(⁵)	40	65	35	60	Crops (corn, hay).
Dyer silt loam.....	50	80	35	50	65	105	65	80	50	65	(⁵)	(⁵)	75	95	60	75	40	65	Crops (corn); idle land.
Tigrett cherty loam.....	40	60	30	50	40	65	45	60	40	50	45	80	60	75	45	65	40	60	Crops (corn, hay); idle land.
Calhoun silt loam.....	40	60	30	50	55	95	55	75	40	65	(⁵)	(⁵)	75	95	55	70	35	60	Crops (corn, hay); forest.
Brandon silt loam, undulating phase.	40	60	40	50	40	75	35	55	30	50	60	80	65	75	55	65	30	55	Crops (hay, corn, tobacco); forest.
Waverly silt loam.....	45	80	10	40	55	100	65	80	50	65	(⁵)	(⁵)	55	75	25	60	40	60	Crops (corn, hay); pasture; forest.
Melvin silt loam.....	45	80	(⁵)	(⁵)	55	100	65	80	50	65	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	(⁵)	40	60	Forest; crops (corn); pasture.
Beechy loam.....	40	70	(⁵)	35	45	95	60	75	45	60	(⁵)	(⁵)	50	70	20	55	35	55	Crops (corn, hay); pasture; forest.
Bodine loam, undulating phase.	40	60	40	50	40	75	35	55	30	50	50	75	65	80	48	60	35	60	Idle land; forest; crops (hay, corn).
Weinbach silt loam.....	30	60	15	45	45	80	40	65	40	65	(⁵)	(⁵)	65	80	50	70	35	60	Pasture; forest; crops (corn, hay).
Memphis silt loam.....	40	60	35	50	40	75	25	45	30	50	45	70	60	70	50	60	30	55	Idle land; crops (hay, corn); pasture.
Loring silt loam, rolling phase.	40	55	30	45	35	65	20	40	30	45	40	65	60	60	45	55	25	50	Do.
Providence silt loam.....	35	50	30	45	35	65	20	40	30	45	45	65	60	70	45	55	25	50	Do.
Lexington silt loam, rolling phase.	30	55	35	50	35	65	25	45	30	45	45	70	55	70	45	55	25	50	Idle land; crops (hay, corn); forest.
Iola gravelly loam.....	25	40	20	45	20	45	15	25	20	30	30	65	(⁵)	(⁵)	30	50	10	30	Crops (corn, hay); forest; gravel pits.
Brandon silt loam, rolling phase.	25	50	30	45	25	60	20	40	25	40	45	65	50	65	40	50	20	45	Idle land; crops (hay, corn); forest.
Henry silt loam.....	25	40	(⁵)	(⁵)	40	65	35	60	30	50	(⁵)	(⁵)	65	80	30	60	25	50	Forest; crops (hay, corn).

FOURTH-CLASS SOILS

POOR TO VERY POOR CROPLAND; DOMINANTLY PASTURE LAND

Melvin silty clay loam.....	30	70	(⁹)	(⁹)	40	80	55	65	50	60	(⁹)	30	50	Forest; crops (corn); pasture.					
Beechy loam, sanded phase.....	(⁹)	40	(⁹)	(⁹)	(⁹)	65	(⁹)	65	(⁹)	50	(⁹)	25	40	Pasture; idle land.					
Memphis silt loam, hilly phase.....	20	40	15	40	20	60	15	40	25	35	25	50	40	55	20	40	20	45	Idle land; forest; pasture.
Lexington silt loam.....	20	40	10	35	20	55	15	35	20	30	25	50	40	55	20	35	15	40	Do.
Lexington loam.....	20	40	10	35	20	55	15	35	20	30	25	50	40	55	20	35	15	40	Do.
Providence silt loam, hilly phase.....	20	40	10	35	20	55	10	35	20	30	20	40	40	55	20	35	15	40	Do.
Brandon silt loam.....	15	35	10	30	15	45	15	25	15	30	20	40	35	50	15	30	10	30	Do.
Carroll silt loam.....	15	30	(⁹)	(⁹)	25	55	25	45	30	40	(⁹)	(⁹)	(⁹)	(⁹)	20	40	20	45	Forest, idle land, crops (hay).

FIFTH-CLASS SOILS

VERY POOR CROPLAND OR PASTURE LAND; DOMINANTLY FOREST LAND

Lexington loam, steep phase..	(⁹)	5	20	Forest; idle land.															
Bodine loam.....	(⁹)	10	30	Do.															
Brandon silt loam, steep phase.....	(⁹)	5	20	Do.															
Brandon gravelly loam.....	(⁹)	Do.																	
Bodine cherty loam.....	(⁹)	Do.																	
Rough gullied land (Brandon soil material).	(⁹)	Idle land.																	
Gravel pit.....	(⁹)	Gravel.																	

¹ Soils grouped in 5 classes according to relative physical suitability for general agriculture

² Soils listed in approximate order of general productivity under prevailing practices.

³ Each index is the expected yield expressed as a percentage of a standard yield of each crop under the specified management. The standard yield of each is listed at the head of the appropriate column and represents the approximate average yield obtained without

use of fertilizer or other amendments on the more extensive and better soils of the region of the United States where most commonly grown.

⁴ For explanation of the term "cow-acre-days" see footnote 4, table 9.

⁵ Amendments rarely applied.

⁶ Crop commonly not grown.

In columns B the yields are those to be expected under average conditions and the usual management. This involves the use of some manure and amendments, except as indicated in the table, but no systematic crop rotation. Hay and pasture generally are not fertilized, nor are the crops and pasture on the bottom lands, except tobacco. Fertilizers are used less commonly on the Wheeling, Sciotoville, and Weinbach soils than on other soils of the uplands or terraces. (Additional information regarding common management is in the separate soil descriptions in the section on Soils and in the discussion of crops in the section on Agriculture.)

In columns C the yields are those to be expected under average conditions and good management. Such management includes well-suited crop rotations that contain legumes, the use of lime and fertilizer where needed, proper use of barnyard manure and crop residues, adequate drainage, and control of runoff. (More definite information regarding good management for the separate soils is given in the section on Soil Management Groups.)

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

Factors influencing the productivity of land are mainly climate, soil, and management. Crop yields over a long period of years furnish the best available summation of these factors. In this county most of the information on crop yields is based on observation and data collected in the field. In some instances, because of a lack of definite information, the yields given represent comparisons with more definite yield data for other soils.

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

The estimated yields in table 9 for the principal crops grown on soils of this county are converted into productivity indexes and the soils grouped according to their desirability for farming in table 10.

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

The indexes in the productivity rating table are the expected yields in table 9 expressed as percentages of the standard yields

adopted for the country as a whole (productivity rating index = $\frac{\text{expected yield}}{\text{standard yield}} \times 100$.) The standard yields on which the indexes are based are stated in the table under the name of the crops for which the ratings are given. Columns B and C under each crop refer to two levels of management and correspond to similar columns in table 9, for which the levels of management are defined.

Table 10 gives a characterization of the productivity of each soil in the county but does not present the relative bearing the different soils have on the agriculture. Total production of crops by soil areas cannot be determined without consideration of the acreage of individual soils used for each of the crops.

The ratings given cannot be interpreted directly into land values because distance to market, relative prices of farm products, association with other soils of different use suitability, and many other factors influence land values at specific places. The ratings, however, can be used for comparing the productivity for specific crops of different soils within the county and for comparing the productivity of the soils of this county with those of other parts of the United States.

The soils of the county are grouped in table 10 into the five classes previously discussed in the section on Physical Land Classification, and the soils within each class are listed in the approximate order of their general suitability for the agriculture of the county. This grouping into five classes is not to be taken as recommendation for the use of any specific field or piece of land. Information on a number of additional factors is necessary in order to make more definite recommendations for the use of a farm or field; specific recommendations for any one farm, however, would require knowledge and consideration of a number of factors pertaining to that specific farm.

WATER CONTROL ON THE LAND

Water control on the land involves the following practices that maintain favorable soil-moisture conditions for plant growth: (1) Regulation of runoff, (2) protection from floods, (3) drainage, and (4) irrigation.

The maintenance of as favorable soil-moisture conditions for plants as feasible through the regulation of runoff is the major problem in the control of water on the land in this county. On many soils the runoff is too swift for a sufficient supply of moisture to be absorbed, but usually the runoff can be regulated so that more moisture can be absorbed for plant use and less left free to cause erosion. Two direct undesirable results from runoff are (1) loss of water that could have been useful to plants and (2) loss of soil material. Loss of water always results, but appreciable loss of soil material may or may not accompany it; of the two, the loss of soil material is more noticeable because an eroded condition is left and its apparent effects are generally cumulative.

Conditions that contribute to the loss of water and soil cannot be corrected separately, as such losses are intimately associated in their causes, in their effect on one another, and in measures for their control. Conservation of both water and soil can be accomplished through the proper control of water on the land.

Little has been done to protect the land from floods, though considerable damage has resulted from overflow of streams. Most floods occur early in spring before crops are on the land. Much land previously subject to flooding and some not covered by overflows will be permanently inundated by the Kentucky Reservoir.

Ditches have been used to drain some areas of poorly drained soils, but little tiling has been done. The use suitability of an appreciable acreage of soils could be materially improved by artificial drainage.

Very little irrigation is practiced in this county at present, though in dry seasons it doubtless would increase yields on many soils. Its use to supplement rainfall might prove economically feasible under some conditions, especially on gardens and on high-value crops, as truck crops.

In the area of the Tennessee River Valley, of which Marshall County is a part, a series of dams has been constructed to control and use the water in the streams for the betterment of the people. These dams improve the waterways for navigation, decrease floods by regulating the volume of flow, and provide a head of water for the generation of electricity. To a large extent their effectiveness depends on their capacity to regulate the flow of the large streams. Many streams of this county feed the main river system, and any measures regulating the flow of water from the land they drain have a bearing on the effectiveness of the system of dams; moreover, the principal means of controlling floods on these feeder streams is through the control of water on the land where it falls.

Water is a natural resource to be utilized on the land as well as in the streams. It is necessary for plant growth, and, even in a region of as high rainfall as the one in which this county is situated, lack of water is commonly a limiting factor in the growth of plants during certain periods of the year. Any measures that bring about a more nearly adequate and even supply of water during the growing season will promote increased plant production.

Effective use of water by plants may be limited by other factors of crop production, and in this county one of the major limiting factors is the supply of mineral plant nutrients in the soil. If the water that falls on the land is to be used most effectively by plants, a sufficient supply must remain in the soil for their needs, an adequate supply of plant nutrients must be available, the physical condition of the soil must be favorable to the development of plant roots, and plant diseases and destructive insects must be controlled.

Vegetation retards the runoff in proportion to its denseness and its ability to condition the soil so that it will absorb and retain water. In addition the vegetative cover and its debris and the root system materially lessen the loss of soil by impeding the runoff and by binding the soil particles. Forest is very effective in reducing the loss of water and soil, and sod-forming crops, as hay, pasture grasses, and some legumes, are rather effective. Close-growing crops, as small grains, are somewhat less effective than sod-forming crops, and intertilled crops are generally the least effective.

Several soil characteristics have direct bearing on the problem of runoff control—of these, slope is of outstanding importance. If the other characteristics are similar, the soils having a steep slope are the most subject to damage by runoff, and their suitability for agri-

cultural use is the most restricted; whereas those having a moderate slope or nearly level relief are the least subject to damage by runoff, and, in general, their suitability for agricultural use is the least restricted. Other soil characteristics that have an important bearing on the problem of runoff control are consistence, texture, and depth to bedrock.

In general, soil use and crop rotations should be so adjusted that a vegetative cover will reduce the damage from runoff. Such cover should be determined by the quantity and rapidity of the runoff as well as by the physical characteristics of the soil. To be most effective the vegetative cover on cropland and pasture land should be vigorous in growth. The use of lime, manure, and fertilizer in suitable quantities and the use of legumes in the crop rotations will help make a vigorous plant growth and thereby help control runoff. Agricultural lime supplies the plant nutrient calcium and adjusts the acidity of the soils. Manure supplies nitrogen, potash, and organic matter and aids in keeping the soil in good physical condition. Commercial fertilizers supplying nitrogen, phosphorus, and potash can be used to supply minor nutrient elements as well. Legumes properly inoculated fix nitrogen from the air; their roots add organic matter to the soil and thus aid in maintaining the soil in good physical condition.

As such practices promote vigorous growth of crops in the rotation, they are desirable not only in the control of runoff but in the effective use of water in the soil for the production of crops.

The soil should be so tilled that it will retard runoff and absorb water. It should be tilled at such time and in such manner as to be bare of vegetation for as brief a period as possible. Contour tillage is beneficial on many slopes by impeding the runoff. Contour strip cropping may be helpful on the steeper slopes and is generally most feasible and most helpful on long slopes.

Terracing and other engineering measures for the control of runoff are commonly expensive. Terraces seem to lower the productivity of some soils, which may entail considerable effort to regain. To be effective, terraces must be maintained in good condition, as poorly kept ones may be worse than none. Under certain conditions terraces have a place in the control of runoff but should be employed only when other measures, consisting essentially of good soil management for good production, are inadequate.¹⁰

Like all other soil-management practices, those for the control of water on the land depend not only on the soil but on conditions peculiar to each farm unit. Each farmer should choose the combination of practices that will meet the requirements of his farm unit and provide as nearly as his operating enterprise will permit the maximum control of water on the land. He should choose practices that will provide the proper medium for plant growth and the plant nutrients necessary for the efficient use of the water conserved. Effective control of water is obtained on many farms in this county and can be obtained on many more by soil-management practices ordinarily considered sound from the standpoint of efficient production.

Water control on the land is a part of successful crop production. It can be accomplished largely through good farming practices, in-

¹⁰ Information on engineering measures for the control of erosion may be obtained from University of Kentucky College of Agriculture Circular 304 (20).

volving the proper choice and rotation of crops, proper fertilization and tillage, control of plant diseases and destructive insects, and, in some places, use of engineering measures.

SOIL ASSOCIATIONS

A soil association is a group of soils occurring together in a characteristic pattern; expressed in another way, it is a landscape definable as to kind, proportion, and distribution of its component soils. It may consist of a very few soils or of many, and these component soils may or may not differ greatly one from another. Each association, however, has a certain recognizable uniformity of soil pattern and each can be described as to its general soil composition.

Soil association maps are useful in giving generalized pictures of the soil resources and physical suitability of relatively broad areas, as communities, counties, States, or large regions, as the Tennessee Valley. They are useful in regional studies such as those involving feasible or probable changes and adjustments in agricultural production, but they cannot provide sufficient information for the study of individual farms or fields; the detailed soil map better serves this purpose.

Five soil associations are recognized in this county—three in the creek and river valleys and the other two chiefly on uplands. The differences distinguishing the three associations on creek and river bottoms from one another are chiefly in parent material and drainage, and those distinguishing the two on the uplands are in parent material and degree of dissection. The distribution of these five soil associations is shown in figure 3, and in the following pages these associations are described in terms of the proportion and pattern of their component soils and the present and potential uses in agriculture of each association is briefly stated.

WEINBACH-WHEELING-HUNTINGTON-EGAM ASSOCIATION

The Weinbach-Wheeling-Huntington-Egam association is on the bottom lands and low terraces of the Tennessee River in a continuous belt $\frac{1}{2}$ to $2\frac{1}{2}$ miles wide along the eastern and northern edges of the county. Its topography is nearly level throughout most of the valley, although this smooth relief is broken in many places by short slopes or escarpments between the bottom land and the higher lying stream terraces. The soils in this association are formed from mixed general stream alluvium washed from a wide variety of materials including limestone; cherty limestone; sandstone; shale; Coastal Plain sand, gravel, and clay; and loessal material. The strong influence of limestone material, however, is evidenced by the slightly neutral to acid reaction of much of the soil of the bottom lands.

Soils on the bottom lands are of the Huntington, Egam, Lindside, and Melvin series and constitute about a fourth of the association. The Huntington soils occupy the leveelike well-drained benches adjacent to the stream channels, while the Egam soil is farther from the river and in many places in lower positions. The Lindside and Melvin soils are in depressed areas and sloughs and along creeks that dissect the bottom lands. The terrace soils are of the Wheeling, Sciotoville,

Weinbach, and Iola series and comprise nearly three-fourths of the association. The Wheeling soils occupy low terrace ridges and the slopes between the terraces and the adjacent bottom lands, whereas the Sciotoville soils are on broad nearly level areas, and the Weinbach soil is in flats or depressions. The Iola soil is in long narrow ridges parallel to the stream channel and generally close to the adjacent uplands.

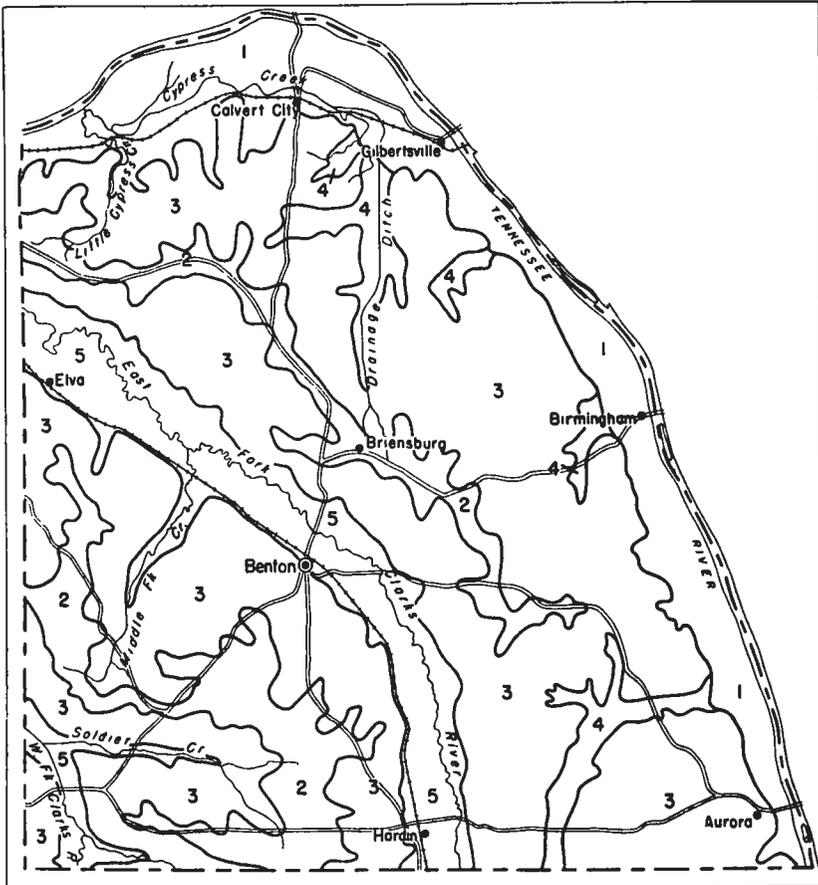


FIGURE 3.—Soil association map of Marshall County Ky.: 1, Weinbach-Wheeling Huntington-Egam; 2, Grenada-Calloway-Providence; 3, Brandon-Hymon-Tigrett-Grenada; 4, Waverly-Calhoun-Beechy; 5, Calhoun-Collins-Vicksburg.

Most of this association is cleared and used for farming, except some areas of the imperfectly and poorly drained soils. Corn is the most important crop on the soils of the bottom lands, and corn, wheat, cotton, and strawberries on those of the terraces; other crops on this soil association are lespedeza, redtop, cowpeas, and soybeans. Beef cattle are important on some farms and hogs on others. Most farms are either of the general or crop-specialty type.

GRENADA-CALLOWAY-PROVIDENCE ASSOCIATION

The Grenada-Calloway-Providence association is on smooth upland plains in two large areas, one on the divide between the Tennessee and East Fork Clarks Rivers and the other on the divide between the East Fork Clarks and West Fork Clarks Rivers. The areas are nearly level with slight relief. The soils are developed from deep loessal deposits and from shallow loessal deposits overlying Coastal Plain sand and gravel.

Important soils in the association are of the Grenada, Providence, Calloway, and Henry series. The Grenada soils are in relatively broad areas on smooth imperfectly drained uplands, and the Providence in small areas generally near the margins of the association areas. Calloway and Henry soils are in small to medium-sized areas on flats or in slightly depressed places. Less extensive soils are members of the Memphis and Loring series, which are on the more sloping parts of the association near its margins and bordering the small stream channels. Members of the Tigrett and Briensburg series are in the shallow drainageways dissecting the association areas.

A large part of this association is cleared and used for crops and pasture, but some of the imperfectly and poorly drained soils are forested. Corn, dark fire-cured tobacco, wheat, strawberries, and lespedeza are the important crops. Other crops grown are cowpeas, sorghum, soybeans, and grass hays. Farms are chiefly of the general or crop-specialty type.

BRANDON-HYMON-TIGRETT-GRENADA ASSOCIATION

The Brandon-Hymon-Tigrett-Grenada association is in thoroughly dissected uplands bordering the valleys of the major streams and is the most extensive in the county. The relief ranges from undulating on the broader stream divides to steep on slopes adjacent to the valleys, but, in general, is strongly rolling to steep (25 to possibly 130 feet in the more deeply dissected areas). The soils of the upland are derived from loess, thin loess over Coastal Plain sand and gravel, and from cherty limestone. Soils in the narrow stream valleys are derived from alluvium and colluvium washed from the soils in the adjacent uplands.

This association includes a large number of soil series, and the pattern is somewhat complex. Grenada and Providence soils are on the broader smoother interstream divides; Memphis, Loring, Lexington, and Brandon soils on the more rolling ridge tops; and Brandon, Lexington, Bodine, and Memphis soils on the hilly and steep slopes. The hilly and steep Brandon soils are the predominant members of this association. Most of the Memphis soils are in the southwestern part of the county, and most of the Bodine are in the southeastern part bordering the Tennessee River terraces and bottom lands. The Hymon and Tigrett soils are important on floors of the deeply incised narrow creek valleys included in the association. Other series in these valleys are Shannon, Beechy, and Briensburg.

Most of the smooth upland and the creek valleys are cleared and used for farming, but a large part of the hilly and steep slopes and much of the narrower more rolling ridge tops are forested. Corn,

wheat, tobacco, lespedeza, and redtop are the more important crops, and dairy cows and poultry for family needs are the chief livestock. Many farms are of the self-sufficing type, but some are general or crop-specialty farms.

WAVERLY-CALHOUN-BEECHY ASSOCIATION

The Waverly-Calhoun-Beechy association is on level land in several creek valleys in the northern and eastern parts of the county, including the valleys of Cypress, Bear, and Jonathan Creeks, and Turpins Pond. The soils are derived from recent to moderately old stream alluvium washed from uplands consisting of loess, Coastal Plain sand and gravel, and cherty limestone.

Beechy, Calhoun, and Waverly are the more important soils in the association. The Beechy and Waverly soils are in relatively broad areas in level to depressed parts of the bottom lands, and the Calhoun soil is on level or depressed parts of stream terraces. Collins and Hymon soils are on the imperfectly drained bottom lands, and Olivier on some terraces. Small areas of Vicksburg and Shannon soils are on well-drained bottom lands. Briensburg and Tigrett soils are on local alluvium and colluvium bordering the valleys.

Probably between 25 and 35 percent of this association is forested, but the rest is cleared and used for farming. Corn is the most important crop, and other crops are lespedeza, grass hays, soybeans, cowpeas, sorghum, and small acreages of tobacco and strawberries. Rather large areas are idle or wasteland. Farms are chiefly of the subsistence or general types.

CALHOUN-COLLINS-VICKSBURG ASSOCIATION

The Calhoun-Collins-Vicksburg association occurs in nearly level small river valleys. One relatively large area about a mile wide is in the valley of the East Fork Clarks River in the central part of the county, and a smaller area is in the valley of the West Fork Clarks River in the southwest corner. The soils consist chiefly of recent to moderately old alluvium washed largely from loessal material but includes some sand and gravel of Coastal Plain origin.

Vicksburg, Collins, Calhoun, and Olivier soils are the most important series in the association. The Vicksburg and Collins occupy broad areas on the well-drained and imperfectly drained bottom lands. The Calhoun and Olivier soils occur on the stream terraces. Other bottom land soils are of the Shannon, Hymon, Beechy, Waverly, and Carroll series. Small areas of Briensburg and Tigrett soils are on the coluvial fans and benches bordering the valley.

Corn, the most important crop, is grown on nearly half of the cropland. Other important crops are lespedeza, soybeans, cowpeas, tobacco, and strawberries. Considerable areas are idle land, and some land is in forest. Most farms are of the general and subsistence types, but a few are crop-specialty farms.

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 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 the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

Climate and vegetation change the parent material from an inert heterogeneous mass to a body having more or less definite genetic morphology. Their action on the parent material is hastened or hindered to varying degrees by the relief, which governs to some extent runoff, natural erosion, the movement of water through the soil, and the natural vegetation. Throughout the genesis of soil, time brings about changes; hence, age is a factor in the development of the soil into a state of even adjustment with its environment. The point to which the soil develops depends not only on time but on the rate at which the forces of climate and vegetation act, these forces, in turn, being regulated by the relief and parent material.

FACTORS OF SOIL FORMATION

Marshall County is near the northern edge of the region of Red and Yellow Podzolic soils and near the southern edge of the region of Gray-Brown Podzolic soils (8). Both podzolization and laterization have been active in the development of its soils, though probably the podzolization process has been dominant.

Western Kentucky is in the Mississippi embayment area, or the northern extension of the East Gulf Coastal Plain. The geologic formations deposited during or after this embayment consist of unconsolidated sand, gravel, and clay of Cretaceous or later age and of a covering of loess or loesslike material over them (19). These deposits rest on Mammoth Cave limestone of the Mississippian period, which comes close enough to the surface to influence the soils only in the hilly eastern part of the county bordering the terraces of the Tennessee River. During the long period this limestone has been subjected to weathering it has been leached to a depth of several feet, leaving a mass of highly resistant chert fragments. No calcareous material is found in any of it, except in a few limestone outcrops at the base of steep hills. These cherty materials have influenced the soils of about 7 square miles.

Nearly all the soils of the uplands have been formed either wholly or partly from weathered loess or loesslike material, which probably originally covered the entire uplands. In some areas, especially on steep slopes, most of it has been removed by erosion, but it ranges in depth from 2 feet or less on the ridges in the hilly eastern part of the county to about 10 feet in some areas of the nearly level western part. Where the covering is shallow, the upper part of the profile has been formed from loessal material but the lower part from sandy or gravelly unconsolidated Coastal Plain deposits or cherty residuum of

limestone. Evidently the loessal material is drift carried by wind from the bottom lands along the Mississippi River, because it deepens as those bottom lands are approached. Although probably originally calcareous, in this county this material has been leached and is acid to a depth of about 6 feet or more (14).

The unconsolidated sandy and gravelly Coastal Plain materials outcrop or come near enough to the surface to influence the soils on most of the steeper slopes, except the cherty ones, throughout the county and on many of the ridges and milder slopes in the more dissected parts. The Lafayette gravel and sand immediately underlie the loessal material in much of the county. They consist of brown, red, or orange stratified or cross-bedded deposits of ferruginous gravel and sand, mainly gravel. Lenses or layers of ferruginous sandstone or conglomerate occur in these deposits in many places. Other lower lying sand formations outcrop in some localities, influencing the soils on the steeper slopes. The Porters Creek formation consists of clay and sand (13), but the clay outcrops are not large enough to influence the soil except in a few local spots. The Coastal Plain materials are not calcareous, but in some places they contain mica flakes.

Alluvium deposited by the Tennessee River is composed of materials washed from limestone areas, though it contains admixtures of materials derived from other sources. It is the least acid of any of the parent materials.

The climate is continental and is temperate and humid. The mean annual precipitation of 46.32 inches is fairly evenly distributed throughout the year. With relatively brief periods of freezing weather, this climate allows moderately rapid and fairly continuous leaching as well as other processes of soil formation. All the soils of the uplands are medium to very strongly acid throughout their solums, except in the thin dark-colored upper part of the surface horizon in some virgin soils.

Originally the territory in which the county is situated was probably covered with an oak-hickory forest. When white men first arrived, some of the more nearly level areas in the southwestern part were described as barrens and were almost treeless, probably caused by the burning of the forest by Indians. Owing to the type of forest cover and to the mild humid climate, the soils are light-colored and low in content of organic matter and nitrogen—such environmental conditions are not conducive to the accumulation of large quantities of organic matter. Under virgin conditions the first $\frac{1}{2}$ to 1 inch of the profile generally is dark-colored and contains considerable organic matter, consisting of partly decayed leaves and twigs, mainly oak and hickory.

The age or stage of development attained by the soils ranges from recent to mature. Most of the soils in the first bottoms are recent, because the soil processes have not acted on the material for a sufficient time for horizons of eluviation and illuviation to be formed. Most soils of the more nearly level and undulating uplands are mature or nearly mature. They have profiles of genetically related horizons and are in equilibrium, or nearly so, with the environment. They show well-developed horizons of eluviation and illuviation, but the number

of horizons depends on the character of the relief and the condition of drainage. The soils on the steeper slopes are young, or immature, and have thinner solums of less well developed horizons, a condition due to rapid runoff and excessive erosion. The soils in nearly level or gently sloping areas of the stream terraces are mature, or nearly so, and in profile characteristics closely resemble soils of the level to undulating uplands.

CLASSIFICATION OF SOILS

The soils of Marshall County are classified in higher categories—soil orders and great soil groups. The orders represented are the zonal, intrazonal, and azonal.

A zonal soil is a member of any one of the great soil groups having well-developed soil characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms, chiefly vegetation. An intrazonal soil is a member of any of the great soil groups with more or less well-developed soil characteristics that reflect the dominating influence of some local factor of relief, parent material, or age over the normal effect of climate and vegetation. An azonal soil is a member of any of the great groups of soils without well-developed profile characteristics, owing to their youth or condition of parent material or relief, that prevent the development of normal soil-profile characteristics (14, 21).

The great soil groups represented in this county include Yellow Podzolic soils, which are somewhat transitional to Gray-Brown Podzolic soils, Planosols, Alluvial soils, and Lithosols. Yellow Podzolic soils are a zonal group of soils having thin organic layers and organic-mineral layers over a grayish-yellow leached layer that rests on a yellow horizon, developed under coniferous or mixed forest in a warm-temperate moist climate. The soil-development processes are podzolization and some laterization (21). In this county the Yellow Podzolic (transitional to Gray-Brown Podzolic) soils comprise the Memphis, Lexington, Brandon, Wheeling, and Bodine series. Brandon gravelly loam and Bodine cherty loam are considered to be somewhat Lithosolic because of their rather close relation to the parent rock.

Planosols are an intrazonal group of soils with eluviated surface horizons underlain by B horizons more strongly illuviated, cemented, or compacted than associated normal soils, developed on nearly flat upland surface under grass or forest vegetation in a humid or sub-humid climate (21). In this county the Planosols are the Loring, Grenada, Calloway, Henry, Providence, Sciotoville, Weinbach, Olivier, Calhoun, and Carroll series.

Alluvial soils are an azonal group developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes (21). The Alluvial soils in this county consist of the Huntington, Egam, Vicksburg, Shannon, Iola, Tigrett, Lindside, Melvin, Collins, Wavery, Hyman, Beechy, Briensburg, and Dyer series. The Lindside, Melvin, Collins, Waverly, Hyman, Beechy, Briensburg, and Dyer soils have slow or very slow drainage.

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 (21). Rough gullied land (Brandon soil material) and Gravel pit are classified as Lithosols in this county.

A classification of the soil series and land types of this county in higher categories and some of the factors that have contributed to their morphology are given in table 11.

The soils of this county may also be classified according to soil catenae. A soil catena is a group of soils within one zonal region developed from similar parent material but differing in characteristics of the solum owing to differences in relief or drainage (21). The soil series of the county are listed in catenary relationship and their parent materials and condition of drainage shown in table 12.

TABLE 11.—*Classification of the soil series and land types of Marshall County, Ky., in higher categories, and some of the important factors that have contributed to their morphology*

ZONAL SOILS				
Great soil group, soil series, and land types	Physiography	Parent material	Relief	Drainage (internal)
Yellow Podzolic (transitional to Gray-Brown Podzolic)	Dissected uplands	Residuum weathered from. Deep loess.	Undulating to hilly	Medium. ¹ Do
Memphis			Undulating to steep	
Lexington		do	do	Do.
Brandon		Shallow loess over very cherty lime- stone residuum	do	Do.
Bodine			do	Do.
Wheeling	Stream terrace lands	Old stream alluvium from mixed sources with strong limestone in- fluence.	Nearly level to gently rolling	Do.
INTRAZONAL SOILS				
Planosols	Smoother uplands	Residuum weathered from Deep loess	Gently undulating to rolling	Medium to moderately slow. Moderately slow.
Loring			Level to gently undulating	
Grenada		do	Nearly level to slightly depressed	Slow
Calloway		do	Level and nearly level	Very slow.
Henry		Shallow loess over Coastal Plain sand and gravel	Gently rolling to hilly	Medium to moderately slow.
Providence	do			
Sciotoville	Stream terrace lands	Old stream alluvium from Mixed sources with strong limestone influence.	Level to gently rolling	Moderately slow.
Weinbach			do	Nearly level and depressed	Slow.
Olivier		Chiefly loessal material	Nearly level to gently undulating	Moderately slow.
Calhoun			do	Level, depressed, or gently sloping	Slow
Carroll		do	do	Nearly level	Very slow.

AZONAL SOILS

Alluvial soils					
Huntington.....	Tennessee River bottom lands.	Stream alluvium from: Mixed sources with strong limestone influence.	Nearly level.....	Medium.	
Egam.....		Small river and creek bottom lands.	do.....	do.....	Medium to moderately slow
Vicksburg.....	Creek and River terraces.....		Chiefly loessal material.....	do.....	Medium.
Shannon.....			Colluvial lands.....	Mixed loessal and Coastal Plain materials	do.....	Do
Iola.....		Chiefly cherty limestone material..	Rolling.....	Rapid.	
Tigrett.....		Colluvium and local alluvium from Coastal Plain and loessal materials..	Nearly level to gently undulating....	Medium.	
Alluvial soils with gleilike hori- zons					
Lindside.....	Tennessee River bottom lands.	Stream alluvium from: Mixed sources with strong limestone influence	Level.....	Moderately slow.	
Melvin.....	Small river and creek bottom lands.	do.....	Level and depressed.....	Slow to very slow.	
Collins.....		Chiefly loessal material.....	Nearly level.....	Moderately slow	
Waverly.....		do.....	Level and depressed.....	Slow to very slow	
Hymon.....	Colluvial lands.....	Mixed Coastal Plain and loessal materials	Nearly level.....	Moderately slow	
Beechy.....		do.....	Level and depressed.....	Slow to very slow.	
Briensburg.....	Colluvial lands.....	Colluvium and local alluvium from Mixed Coastal Plain and loessal materials.	Nearly level to gently undulating....	Moderately slow.	
Dyer.....		do.....	do.....	Slow.	
Lithosols					
Rough gullied land (Brandon soil material)	Dissected uplands.....	Residuum from Coastal Plain gravel and loess.....	Gently rolling to steep.....	Medium to rapid	
Gravel pit.....		Coastal Plain gravel.....	Hilly and steep.....	Rapid.	

¹ Medium drainage consists of optimum internal drainage conditions for the development of a normal soil

² Bodine soils, now restricted entirely to Lithosols, were much more broadly defined at the time this survey was made and included soils showing Planosolic characteristics.

TABLE 12.—*The catenary relations of the soil series of Marshall County, Ky.*

UPLANDS					
Parent material	Drainage ¹				
	Very slow	Slow	Moderately slow	Medium	Rapid
Residuum weathered from:					
Deep loess.....	Henry....	Calloway....	{Loring ² {Grenada.....	}Memphis....	
Shallow loess over Coastal Plain sands.....			Providence ²		Lexington....
Shallow loess over Coastal Plain gravel.....			.....do ²	Brandon....	
Shallow loess over chert and very cherty limestone.....			Bodine ²	Bodine ²	
TERRACE LANDS					
Old stream alluvium from:					
Loessal materials.....	Carroll....	Calhoun....	Olivier.....		
Mixed sources on the Tennessee River terraces.....		Weinbach....	Scotoville....	Wheeling....	
Chert and cherty limestone.....					Iola.
BOTTOM LANDS					
Colluvium and local alluvium from:					
Mixed Coastal Plain and loessal materials.....		Dyer.....	Briensburg....	Tigrett.....	
Recent or young general alluvium from:					
Loessal materials.....		Waverly ²	Collins.....	Vicksburg....	
Mixed Coastal Plain and loessal materials.....		Beechy ²	Hymon.....	Shannon....	
Mixed sources; medium-textured materials on the Tennessee River bottom lands.....		Melvin ²	Lindside....	Huntington....	
Mixed sources; fine-textured materials on the Tennessee River bottom lands.....		.....do ².....	.....do.....	Egam.....	

¹ The natural drainage conditions under which the soils were formed. The soils of the uplands and terrace lands have somewhat similar genetic profiles, those of the bottom lands have similar color profiles but are recent or young.

² Medium to moderately slow drainage.

³ Slow to very slow drainage.

DESCRIPTIONS OF SOILS REPRESENTING GREAT SOIL GROUPS

Most of the soils of the uplands and terraces have formed either under conditions of poor or imperfect drainage or of excessive erosion. Only a few may be regarded as normal well-drained soils of the area. Memphis silt loam, undulating phase, is a normal Yellow Podzolic (transitional to Gray-Brown Podzolic) soil, developed from noncalcareous loess. It is well drained and has formed in well-dissected areas where the relief is gently undulating and the slope 2 to 5 percent.

Following is a profile description of Memphis silt loam, undulating phase, as observed in an excavation in a long, relatively narrow forested ridge top about 2 miles southwest of Brewers and four-fifths of a mile northeast of the southwest corner of the county:

1. A thin covering of undecayed leaves and twigs, largely from oaks.
2. About 1/8 inch of partly decayed leaves and twigs.
3. 0 to 1 inch (moist), dark grayish-brown mellow smooth silt loam containing many fibrous roots and a few small soft dark-colored iron concretions. pH 5.4.

4. 1 to 4½ inches (moist), light grayish-brown mellow smooth silt loam having weak platy structure and breaking readily into soft fine crumbs. When dry, it is light brownish gray of pale-yellow tinge. This horizon contains a few strong-brown splotches, a few small soft dark-colored iron concretions, many fibrous and fine roots—some medium sized—and a few worm holes and casts. pH 5.4.
5. 4½ to 9 inches (moist), pale yellowish-brown to brownish-yellow mellow smooth silt loam having weak platy structure and breaking easily into soft fine crumbs. It is grayer in the upper part and yellower in the lower and contains a very few small soft dark-colored iron concretions and numerous fine and medium-sized roots. pH 5.4.
6. 9 to 15 inches (moist), bright yellowish-brown to brown moderately friable and moderately porous silty clay loam, medium plastic when wet. It breaks into ¼-inch rounded to subangular nuciform aggregates, which with medium to slight pressure break into firm fine crumbs. The aggregates are browner on the outside. This layer contains a few very small soft dark-colored iron concretions, numerous fine and medium-sized roots, and few old channels lined with brownish-gray material. pH 5.6.
7. 15 to 29 inches (moist), strong yellowish-brown to brown slightly compact moderately friable and moderately porous heavy-textured silty clay loam, breaking into subangular to rounded nuciform aggregates that with moderate pressure break into fine crumbs. The aggregates are browner on the outside and yellower on the inside; some are coated with a black material. Many fine and medium-sized roots are in this layer. pH 5.6.
8. 29 to 50 inches (moist), strong or moderate yellowish-brown to brown friable moderately porous heavy-textured silt loam to light-textured silty clay loam, breaking into ¼-inch barely distinct rounded to subangular aggregates that with slight pressure separate into fine crumbs. The aggregates are browner on the outside than within, and some have a black coating. This layer contains some fine and medium-sized roots. pH 5.6.
9. 50 to 76 inches (moist), moderate yellowish-brown to brown friable very porous gritty heavy-textured silt loam or heavy-textured loam containing some fine, medium, and coarse sand. The material breaks into indistinct rounded to subangular medium-sized aggregates that break with slight pressure into fine crumbs. A few channels filled with grayish-colored material are in this layer, and roots are slightly less numerous than in the layer above. pH 5.7.
10. 76 inches (moist), strong or moderate yellowish-brown to brown very friable and very porous gritty light-textured sandy clay loam containing many rounded chert pebbles as much as 2 inches in diameter. Some gray mottlings are in the upper part of the layer. The material breaks into soft medium-sized rounded to subangular aggregates. pH 5.7.

The profile is medium to strongly acid throughout, but the original loess was probably calcareous. The soil has developed under an oak-hickory type of forest. Organic-matter content is low, except in the thin dark-colored surface horizon.

Other well-drained soils of the gently undulating to gently rolling uplands are the undulating and rolling phases of Brandon and Lexington silt loams. These soils have developed where the covering of loessal material is shallow, or less than 42 inches deep. The upper part of their profile was formed from noncalcareous loess or a mixture of loessal and Coastal Plain materials, and the lower part from unconsolidated Coastal Plain gravelly, sandy, or sandy clay materials. The Coastal Plain parent material of the Brandon soils is gravelly, consisting principally of rounded chert pebbles, whereas that of the Lexington soils is sandy or sandy clay material. All these well-drained soils have developed under conditions similar to those under which Memphis silt loam, undulating phase, developed, except that the slope of the rolling phases is stronger.

The other members of the Brandon and Lexington series occupy areas of rolling to steep relief in which erosion is active and in places excessive. The stronger relief, together with the greater runoff that has caused less vigorous growth of plants and less active soil-forming processes, has produced somewhat thinner solums with slightly less heavy-textured and less well-developed B horizons. In most places these horizons are brown or have a reddish-brown tinge, probably due to the better drainage and oxidation of the profile.

The soils of the Wheeling series are derived from old alluvium deposits on terraces of the Tennessee River. They are similar to Memphis silt loam, undulating phase, in main profile characteristics and stage of development, except that the very fine sandy loam type does not have such a heavy-textured and well-developed B horizon.

The young or immature soils of the Bodine series are classified as Yellow Podzolic (transitional to Gray-Brown Podzolic) soils though they show some Planosolic characteristics. They have formed from a shallow covering of noncalcareous loess over highly weathered material of cherty limestone. In most places the relief is hilly to steep, and the soils are similar in color to those of the Loring. The gray mottled condition of the lower subsoil apparently has been brought about by the obstruction of internal drainage by a compact mass of angular chert fragments. In a few places these fragments appear to be weakly cemented together.

About 41 percent of the county is occupied by Planosols which have formed under conditions of imperfect to very poor drainage. They have gray or gray mottled lower subsoils or silt pans, or clay pans, which are more or less compact and dense and of varying permeability to water. The soils that developed under imperfect drainage conditions have grayish-brown surface soils, yellowish-brown friable upper subsoils, and mottled-gray slightly to very compact lower subsoils. The soils of the Grenada, Loring, Providence, Olivier, and Sciotoville series have this kind of profile. About 16 percent of the county is occupied by the Grenada soils, which have developed wholly from loessal materials in areas of nearly level to gently undulating relief. All these soils are classified as Planosols because of their strongly illuviated and compacted layer. Grenada silt loam may be considered as representative of the Planosols great soil group in this county.

Following is a profile description of Grenada silt loam, as observed in an excavation in a forest about 3 miles southeast of Brewers and about three-fifths of a mile southeast of Jackson School:

1. A rather thick covering of undecayed leaves and twigs, largely oak and hickory.
2. A very thin layer of dark grayish-brown partly decayed leaves and twigs.
3. 0 to 1 inch (moist), dark grayish-brown mellow smooth silt loam having a fairly distinct soft fine-crumb structure. It contains many fibrous roots, much fungus growth, and some partly decayed leaves. pH 6.8.
4. 1 to 4 inches (moist), grayish-brown mellow very porous smooth silt loam, slightly darker in the upper part and grayer when dry. It is a soft fine-crumb structure and contains a moderate quantity of very small soft dusky reddish-brown and dark-colored iron concretions, many fibrous and fine roots, some medium-sized roots, and some worm holes and casts. A slight fungus growth is in the channels. pH 5.4.
5. 4 to 8 inches (moist), light-brown to light yellowish-brown mellow very porous smooth silt loam of soft fine-crumb structure containing a few very small soft dark-colored iron concretions, numerous fine and medium-sized roots, a slight fungus growth in channels, and some worm holes and casts. pH 5.4.

6. 8 to 14 inches (moist to wet), bright yellowish-brown mellow porous smooth silt loam of soft fine-crumb structure containing a few small soft dark-colored iron concretions, numerous small, medium, and large roots, and a slight fungus growth in channels. pH 5.3.
7. 14 to 21 inches (moist to wet), yellowish-brown mellow porous smooth silt loam which breaks easily into soft crumbs, somewhat larger than those in the above layer. It contains slightly fewer roots than that layer, many small soft dusky reddish-brown and dark-colored iron concretions, and a few $\frac{1}{4}$ -inch semihard iron pellets. pH 5.1.
8. 21 to 29 inches (moist to wet), pale yellowish-brown mottled with gray friable moderately porous light-textured silty clay loam, which is slightly plastic when wet. Its aggregates range from soft-crumb to small soft rounded nuciform structure. It contains numerous small dusky reddish-brown soft iron concretions and semihard iron pellets as much as $\frac{3}{8}$ -inch in diameter. Fairly numerous medium-sized and large roots are in this layer. pH 4.8.
9. 29 to 41 inches (moist), medium-gray, containing considerable yellowish-brown, brownish-gray, and rusty-brown mottlings, moderately compact and dense silty clay loam or light-textured silty clay, very plastic and moderately sticky when wet. It breaks into $\frac{1}{4}$ - to $\frac{3}{8}$ -inch firm subangular nuciform aggregates that may be crushed to smaller subangular aggregates. In the upper part of the layer the aggregates are coated with a light-gray silty material, more noticeable when dry, and in the lower part with gray fine-textured glossy material. This layer contains a great many soft dusky reddish-brown and dark-colored iron concretions and a few medium-sized roots. It is slowly permeable to water. pH 4.6.
10. 41 to 96 inches (dry to moist), pale yellowish-brown with some gray mottlings, somewhat porous, slightly compact, and slightly friable heavy-textured silt loam, which with moderate pressure breaks into small fragments. It contains a few root channels coated with a yellowish-white silty material, a few small roots, and a very few soft rusty-brown iron concretions. Below a depth of about 52 inches the material is dry and hard. pH 4.5.
11. 96 to 132 inches (dry), mottled gray and pale yellowish-brown compact hard silty clay loam, moderately plastic when wet and contains a few rusty-brown splotches and concretions. A few pores and apparently a few particles of fine sand are present. pH at 97 inches, 5.9; at 108 inches, 6.2; and at 120 inches, 6.9.
12. 132 to 156 inches (dry), reddish-yellow, splotched with gray and bright red, hard moderately compact clay loam containing much fine sand. It is moderately plastic and sticky when wet. pH at 144 inches, 7.0.

This profile is in a locality where the relief is nearly level to gently undulating and the slope about 2 percent. The soil has developed under an oak-hickory type of forest. The organic-matter content is low, except in the thin dark-colored topmost layer. The original loess probably was calcareous.

The level phase of Grenada silt loam has a profile similar to that of the normal phase, except that its heavy-textured compact lower subsoil generally is at less depth and generally is somewhat thicker, more dense and compact, but less permeable.

The Grenada soils resemble the Memphis soils in their upper horizons, but the upper part of their subsoils contains more yellow. They differ mainly in having a siltpan. Grenada soils occur in areas that have undergone very little dissection and where natural drainage is not well established, whereas practically the contrary applies to the Memphis soils.

Loring silt loam is intermediate in drainage conditions and profile characteristics between Memphis and Grenada silt loams. Although these three soils have similar slope, the general dissection of the area in which each is typical differs. Loring silt loam is typically developed in areas that are not so well dissected as those in which Memphis

silt loam is developed but are more dissected than those in which Grenada silt loam is developed. The Loring soil resembles the other two in the upper part of the profile but differs mainly in having a weakly developed siltpan.

The Providence soils have characteristics somewhat similar to those of the Loring, except that the lower part of the profile has been derived from gravelly or sandy Coastal Plain material.

Well-developed soils, developed under poor or very poor drainage conditions on nearly level to slightly depressed positions, belong to the Henry, Calloway, Carroll, Calhoun, and Weinbach series. They have gray or gray mottled profiles which have very compact dense very slowly permeable claypans or siltpans. Erosion is at a minimum, but the soils are more leached and more acid than those of normal profiles.

Henry and Calloway silt loams have formed on the uplands from noncalcareous loess. Henry silt loam typically is on level and generally the most poorly drained areas of the uplands. Many of these areas possibly originally were small shallow lakes or ponds, but most of them now have one or more drainage channels. Gentle slopes are adjacent to many of these channels. Henry silt loam has a light-gray slightly mottled highly leached mellow silt loam surface layer, which at a depth of 11 to 14 inches abruptly passes into a gray very compact dense plastic silty clay containing a few mottlings. Calloway silt loam is intermediate in drainage condition and profile development between Henry silt loam and Grenada silt loam, level phase. It is in nearly level areas or depressions at the sources of drainageways. Its profile is dominantly gray but highly mottled, and the claypans lie at a lower depth than in the profile of Henry silt loam.

The Carroll and Calhoun soils are on terraces of the smaller streams and have formed mainly from loessal material. Their drainage condition and profile development are somewhat similar to that of the Henry and Calloway soils, respectively. The Weinbach soil is on terraces of the Tennessee River, having formed mainly from old alluvium deposited by that river. It resembles the Calloway soil in drainage condition and profile development.

The Alluvial soils are practically all recent in age and have no horizons of definite eluviation and illuviation, though a gleilike layer is in the profile of some of them. Many receive new material deposited during floods. Some of the better drained soils have a subsoil that is yellowish than the surface soil.

Egam silty clay loam, in the bottoms along the Tennessee River, appears to have some profile development. It has a heavy-textured tough rather compact subsoil composed probably of a heavy-textured layer of the original alluvial deposit. In places, however, a color profile is apparent, and slight structural development has taken place in the subsoil.

In this county the Lithosols are represented by two miscellaneous land types—Rough gullied land (Brandon soil material) and Gravel pit. In the former the profile nearly everywhere has been altered or destroyed by excessive accelerated erosion. In the latter, consisting of gravel beds, no genetic profile probably has ever been formed.

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