
Soil Survey

Hall County Georgia

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SOIL SURVEY OF HALL COUNTY, GEORGIA

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COUNTY SURVEYED

Hall County is in the north-central part of Georgia (fig. 1). Gainesville, the county seat, is 50 miles northeast of Atlanta and 50 miles south of the Georgia-North Carolina state line. The county is irregular in outline with its longest dimension extending in a northeast-southwest direction. It comprises a land area of 427 square miles, or 273,280 acres.

This county is in the upper or higher part of the Piedmont Plateau, and its northern boundary is only 25 or 30 miles south of the Blue Ridge. It consists of a high plateau severely dissected in many places by stream valleys. The land ranges from almost level to broken and hilly. In general, the smoothest areas occur on the broader divides in the north-central, southeastern, and southern parts of the county; east of Clermont; and southwest of Gainesville. The more hilly, broken, and steep areas occupy the heads of drainageways and border the Chattahoochee, Chestatee, and Oconee Rivers and their larger tributaries. Some rough hilly areas are just southeast of Gainesville.

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

The elevation for the greater part of the county ranges from about 1,000 to 1,200 feet above sea level. The lowest elevation, less than 800 feet,² is in the southeastern part along Walnut Fork, approximately 11½ miles southwest of Belmont. In the northern part a few isolated peaks are more than 2,000 feet above sea level. The most easily observed plateau remnant enters the county at Lula and extends southwestward, paralleling United States Highway No. 23. The elevation of this plateau at its crest is between 1,200 and 1,300 feet. The Chattahoochee River, which roughly parallels this ridge along the northwest side, is entrenched from 250 to 400 feet below the general

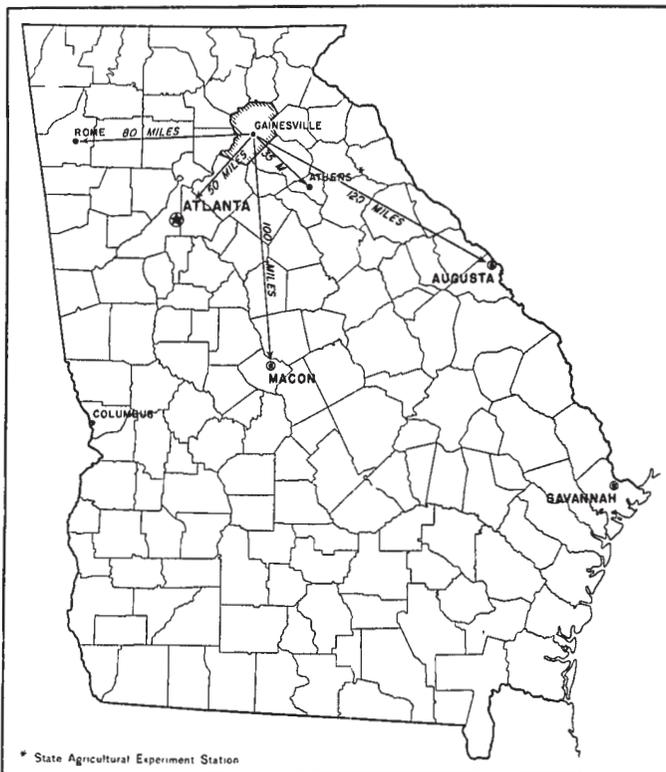


FIGURE 1.—Sketch map showing location of Hall County, Ga.

level of the plateau. Most of the streams have V-shaped valleys. Only narrow areas of first bottoms and terraces border the rivers and large creeks. In places, these bottom lands are practically absent and the water flows through narrows or over cascades, which afford sites for the development of power.

This county is on the drainage divide between the Atlantic Ocean and the Gulf of Mexico. Approximately two-thirds of its area drains into the Gulf through the Chattahoochee River, whereas the eastern one-third drains through the Oconee River into the Altamaha River, which flows into the Atlantic Ocean. All the upland soils are well

² Gainesville, Ga., U. S. Geol. Survey topographic sheet.

to excessively drained. Long narrow areas of first-bottom soils that once were well drained now are poorly drained, owing to filling of the stream channels by materials washed from the uplands. There are, in addition to the rivers, many creeks, branches, and intermittent drainageways. Every farm is connected directly or indirectly with some of these drainageways. Both sheet and gully erosion have been and still are active on a large part of the land, where clean cultivation has prevailed for several years.

The original oak-pine forest was typical of a broad area extending from the Appalachian Mountains eastward and southward to the Coastal Plain. The present tree growth is similar to the original but is less extensive. The dominant oaks are white oak (*Quercus alba*), mossycup or bur oak (*Q. macrocarpa*), common red oak (*Q. rubra*), scarlet oak (*Q. coccinea* var. *tuberculata*), black oak (*Q. velutina*), and blackjack oak (*Q. marilandica*). Shortleaf pine (*Pinus echinata*) is the dominant pine tree, with a few scrub pine (*P. virginiana*) and loblolly pine (*P. taeda*). In the undergrowth flowering dogwood (*Cornus florida*), greenbrier (*Smilax* sp.), wild rose (*Rosa* sp.), and blackberry briars (*Rubus* sp.) are common. Abandoned fields are covered with broomsedge or here and there with Bermuda grass. Those that are not burned over frequently are gradually taken over mainly by young pine, together with a few cedar, sassafras, or oak trees.

Hall County was created by an act of legislature on December 15, 1818, from lands acquired by treaty with the Cherokee Indians in the same year. It was named in honor of Lyman Hall, a signer of the Declaration of Independence. The early settlers were largely descendants of English, Scotch, and Irish people who came from older settlements in Georgia and the Carolinas.

According to the United States census the population numbered 30,313 in 1930. This represents an increase of 13 percent over the number reported in 1920. Of the total population in 1930, 26,897 were native whites, 3,390 Negroes, and only 26 foreign-born whites. Slightly less than one-half (14,342 persons) were classed as rural-farm population. An additional 7,347 persons were classed as rural-nonfarm. Approximately one-third of the Negroes were living on farms. The rural population is evenly distributed throughout the county.

Gainesville was located and made the county seat in 1821,³ and 10 years later the town was well established. In 1930 it had 8,624 residents. Owing to its central location and industrial facilities, Gainesville serves as the principal market and trading center. Other trading centers are Flowery Branch, Oakwood, and Lula located on the Southern Railway, Belmont in the southeastern part of the county on the Gainesville Midland Railway, and Clermont in the northern part, and numerous small stores are located at convenient points. In addition to the two previously mentioned railroads, of which the Southern is double tracked, another branch of the Southern extends from Lula to Athens. Two bus lines are in operation.

Two Federal highways and one State highway intersect at Gainesville. United States Highway No. 23, leading to Atlanta, furnishes an important outlet for local agricultural products. The Federal

³ Information furnished by the Gainesville Chamber of Commerce.

highways are paved or in the process of improvement. The main county roads are graded and surfaced with sand, clay, or gravel. Most secondary roads are graded.

There are 6 senior high schools, 9 junior high schools, and about 30 grammar schools for white children; also 3 high schools and a number of grammar schools for Negroes. Riverside Military Academy for boys was established in Gainesville in 1907 and Brenau College for Women in 1878.

Electricity for light and power is furnished to Gainesville and some of the surrounding communities by the Georgia Light & Power Co. Power formerly was obtained from the Dunlap power dam located northwest of Gainesville along the Chattahoochee River.

Cotton mills furnish the principal manufacturing industry. The first mill was established in Gainesville in 1898, another in 1901. In 1926 the Chicopee village and mill was constructed south of Gainesville. In 1933 a hosiery mill was established in Gainesville. These mills contribute to the general prosperity of the community and supply an important local market for cotton. Other industries have been developed to supply the needs of the cotton mills and the surrounding agricultural communities.

CLIMATE

Cool summers and moderately mild winters characterize the climate. During a 36-year record of the United States Weather Bureau station at Gainesville, July averaged the hottest month. The average maximum temperature for that month was 87.8° F., and the average minimum temperature was 66.7°. Summer nights are cool. The mean temperature rises gradually from January, the coldest month, to July. Prevailing westerly winds in winter bring pronounced changes in the temperature and greatly diminish the ameliorating effect of the Atlantic Ocean and the Gulf. Thus, the county partakes of the continental climate characteristic of the interior part of the United States. When severe cold waves strike the Midwest, freezing and occasionally zero temperatures may prevail in Hall County for short periods. Although these cold spells are short and mild compared with prevailing temperatures in the States to the north and northwest, they tend to kill or check innumerable insect pests. During these periods the ground freezes to depths of 6 or 8 inches. Freezing loosens the surface soil thoroughly and makes subsequent farming operations much easier, but on slopes it has the unfavorable effect of causing the soil to be much more susceptible to erosion.

Rainfall generally is heaviest during the winter, especially in February and March. It decreases sharply during April and May, then increases gradually to its second peak in July. Ordinarily, October and November are the driest months. This distribution of rainfall is very favorable, both for the growth of farm crops and for most farm operations. The period of low rainfall during late spring allows time for planting and preparing the ground; the heavy rains in early spring and late summer furnish an abundance of moisture for growing crops; and the dry fall is a favorable ripening and harvesting period. It is probable that on the higher elevations in

the northern part of the county the precipitation is slightly heavier than at the station at Gainesville.

Although there is a great difference between the mean precipitation of the driest and wettest years, droughts are infrequent. Weather records show that the total amount of rainfall each year is relatively uniform and well distributed throughout the year. For example, in only 6 years of the Gainesville station's record was the total rainfall less than 41 inches; and in 24 years the rainfall ranged from 51 to 60 inches.

The average date of the last killing frost at Gainesville is April 4, and the average date of the first is October 30. This gives an average frost-free season of 209 days. Killing frost has occurred as late as April 21 and as early as October 9. It is probable that on higher elevations in the northern part of the county killing frosts average a few days later in spring and earlier in fall than the above-mentioned dates, giving a slightly shorter frost-free season. This is especially true on some of the north-facing slopes that receive the least sunshine.

The prevailing wind is from the west, although most of the heavier rains are carried by easterly winds. Strong winds, cyclones, and hailstorms are rare.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation at Gainesville, Ga. These data may be considered representative of the climatic conditions in Hall County as a whole.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Gainesville, Hall County, Ga.

[Elevation, 1,254 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1904)	Total amount for the wettest year (1929)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December.....	42.8	74	1	5.46	1.88	2.36	0.9
January.....	41.8	75	-1	4.74	3.27	5.26	1.2
February.....	43.3	79	-6	5.38	1.96	9.72	1.3
Winter.....	42.6	79	-6	15.58	7.11	17.34	3.4
March.....	51.2	88	6	5.63	4.50	12.60	.2
April.....	59.3	93	25	3.99	1.49	4.55	(¹)
May.....	67.8	97	33	4.00	2.68	7.22	0
Spring.....	59.4	97	6	13.62	8.67	24.37	.2
June.....	75.0	100	41	4.13	1.42	6.46	0
July.....	77.7	106	50	5.35	1.60	9.15	0
August.....	76.3	104	51	4.61	2.03	1.29	0
Summer.....	76.3	106	41	14.09	5.05	16.90	0
September.....	71.6	103	35	3.69	.34	12.26	0
October.....	60.7	93	20	3.25	.12	4.82	(¹)
November.....	50.2	79	12	3.06	2.22	7.23	.2
Fall.....	60.8	103	12	10.00	2.68	24.31	.2
Year.....	59.8	106	-6	53.29	23.51	82.92	3.8

¹ Trace.

AGRICULTURAL HISTORY AND STATISTICS

The agricultural development of Hall County dates from 1818, when the Cherokee Indians ceded the land in this section to white people. Settlers rapidly cleared the land of its timber and began cultivation. By 1831 Gainesville is reported to have had a population between 300 and 400.⁴ The early agriculture was self-sufficing. The main crops were corn, wheat, oats, barley, and rye, supplemented by garden vegetables and fruits. Cattle, hogs, and sheep were raised for meat, and wool was spun and woven for clothes. Transportation was slow. Boats and pack horses carried most of the products traded, and frequently the settlers covered long distances on foot. Most of the labor was performed by the family, and one family could cultivate only a few acres by the crude methods used. Very little slave labor was used, as practically no market existed for agricultural products. The sandy soils were preferred, as they were the most easily worked with the available implements.

Gradual development of transportation and high prices for cotton during the early 1830's rapidly changed this self-sufficient type of agriculture into a one-crop system.⁵ Short-staple cotton soon became the cash crop, and slave labor became more and more important. The combination of clean cultivation, moderate to steeply sloping topography, and high rainfall, particularly during winter while the ground was barren, rapidly depleted soil fertility and greatly accelerated erosion. Since slaves were expensive, owing to the great demand for their services farther west, and land values were comparatively low, farmers abandoned old fields as yields decreased and cleared new land. Enormous losses of soil and soil fertility through erosion resulted.

Although corn often exceeds cotton in acreage, cotton remains the chief cash crop. The census report for 1929 lists the total value of all farm crops sold or traded as \$1,138,710, of which 92.7 percent represented the value of farm crops sold or traded on the 2, 213 farms that obtained at least 40 percent of their total income from cotton. This illustrates the dominance of cotton in the agriculture.

Table 2 gives the value of agricultural products, by classes, produced in 1929.

TABLE 2.—*Value of agricultural products, by classes, in Hall County, Ga., in 1929*

Products	Value	Products	Value
Forest products cut on farms for home use and for sale.....	\$97, 468	Fruits and nuts.....	\$26, 729
Farm garden vegetables (excluding potatoes and sweetpotatoes) for home use only.....	72, 536	All other field crops.....	¹ 1, 274, 735
Cereals.....	352, 971	Dairy products sold.....	68, 079
Other grains and seeds.....	5, 732	Poultry and eggs produced.....	210, 307
Hay and forage.....	17, 906	Wool shorn.....	6
Vegetables (including potatoes and sweetpotatoes).....	57, 979	Honey produced.....	1, 927
		Total.....	2, 184, 375

¹ Mainly cotton.

⁴ See footnote 3, p. 3.

⁵ STINE, O. C., and BAKER, O. E. COTTON. U. S. Dept. Agr., Atlas of American Agriculture, pt. 5, The Crops, sec. A, Adv. Sheets 4, p. 19. 1918.

Table 3, giving the acreages of principal crops in the years 1879, 1889, 1899, 1909, 1919, 1929, and 1934, shows the trend of agriculture.

TABLE 3.—Acreage of the principal crops grown in Hall County, Ga., in stated years

Crop	1879	1889	1899	1909	1919	1929	1934
	<i>Acres</i>						
Corn.....	26,632	25,688	33,727	28,614	31,477	23,270	29,859
Cotton.....	12,245	18,828	19,735	31,961	37,571	32,390	20,900
Wheat.....	8,771	6,455	8,345	3,575	2,689	1,229	3,865
Oats:							
Threshed.....	4,798	5,445	1,092	2,164	677	344	519
Cut and fed unthreshed.....						899	2,084
Rye.....	369	102	183	84	135	168	181
Peanuts.....					108	103	464
Dry peas.....			367	273	570	273	2,192
Sorgo.....		425	141	487	603	252	369
Potatoes.....		73	16	39	118	231	921
Sweetpotatoes.....	375	497	393	470	605	352	921
Hay and forage:							
Sorghums for silage, hay, and fodder.....	112	1577	2,427	1,296	18,076	1,803	3,888
Legumes for hay.....					2,752	597	2,067
					669	160	1,305
	<i>Trees</i>						
Apples.....		43,735	48,026	43,580	36,607	27,346	36,414
Peaches.....		38,708	42,324	93,362	30,407	30,772	33,027

¹ Hay only.

² Mostly corn cut for forage.

The maximum acreage of cotton in 1919 was due to the stimulus of war-time prices. According to census reports, the average production during each enumeration ranged from about one-third to one-half bale an acre, the higher averages being reported in the more recent enumerations. Heavier applications of fertilizer and improved varieties of cotton largely explain the higher yields. Owing to changes in market demand for grades of cotton and to the development of superior varieties, most of the varieties planted today were unknown 25 years ago. The leading varieties, in order of their acreage, in 1935 were Farm Relief, Stoneville No. 2, Rucker, Wannamaker, Cleveland, and Addison. Cotton was planted on 20,900 acres in 1934.

In most years the acreage of corn exceeds that of cotton. In 1934 corn, including that for forage, was planted on 30,263 acres. Yields are low, in most years ranging from 11 to 13 bushels an acre. Although about one-half of the cultivated land was occupied by this crop in 1934, it is doubtful whether enough corn was produced to supply the local demand. It is fed to work animals, cows, and poultry; to fatten a few hogs; and to provide a small quantity of meal for use in the home.

Wheat ranked third in acreage in 1934 and was grown on 3,865 acres. As only enough is produced to provide flour for home use, it is commonly grown only in small areas and is harvested by hand.

Oats were grown on 2,603 acres in 1934. Those from 2,084 acres were cut and fed unthreshed and from 519 acres were threshed for grain.

Legume crops include cowpeas, lespedeza, crimson clover, soybeans, velvetbeans, and peanuts. In 1934, cowpeas from 2,002 acres produced 10,980 bushels. Cowpeas from an additional 1,398 acres were grown with other crops.

Sorghum is an important forage crop; 2,558 tons were produced from 2,067 acres in 1934. That from an additional acreage was harvested for grain.

On many farms, truck crops, tobacco, sorgo, orchard fruits, grapes, and small fruits are produced in sufficient quantities to supply the needs of the home and a small excess for sale on the local markets. The production of boxwoods and other ornamental plants, as a means of increasing the cash income, receives special attention on some farms. Practically all of these minor crops are adapted to the soils and climate, but the lack of good nearby markets and a general feeling among the farmers that they must have a strictly reliable cash crop preclude their extensive production.

Within the last few years owner operators and better tenants are producing more feed for livestock and are making their farms more nearly self-sufficing. Evidence of this tendency is apparent in the increased production of corn, wheat, oats, forage, and other minor crops in contrast to the total acreage of cotton.

Livestock raising is a minor enterprise. Most farmers do not have enough fenced pasture to care for large numbers of livestock. A few, however, do raise beef cattle. Several small dairy farms specialize in the production of milk and other dairy products, particularly for the Gainesville market. Twenty-three farms are listed as specializing in the production of poultry and eggs. Many farmers have small surpluses of poultry and dairy products, which are sold on the local markets.

The census reports 253 horses and 3,041 mules on farms on January 1, 1935. Most of the horses and mules are imported from Tennessee or farther west. Light work animals weighing from 1,000 to 1,300 pounds are preferred.

Of the 7,759 head of cattle reported by the 1935 census, 4,777 were cows and heifers over 2 years of age. Although grade Jerseys predominate, a few registered cattle of the Jersey, Guernsey, or Holstein-Friesian breeds are kept by dairy farmers.

Sheep and swine on farms in 1935 numbered 18 and 3,372, respectively. Brood sows are kept on only a few of the larger farms. Most farmers buy one or two pigs and keep them in pens until they are large enough to be slaughtered for meat.

In 1929, 88.2 percent of the farmers reported the purchase of fertilizer at a total cost of \$202,467, or an average of \$81.02 per farm reporting. Among the fertilizer materials purchased were 6,839 tons of commercial fertilizer.

In 1929, 1,007 automobiles were in use on 962 farms, or about one-half of the farms in the county. In addition, 205 motor trucks, 62 tractors, and 27 electric or gasoline engines were reported. Telephones were reported on 152 farms, water piped into the house on 43 farms, and electricity on 73 farms.

Comparatively small areas are fenced, generally with barbed wire. The condition of farm buildings varies widely. On some of the larger farms located on the better soils the buildings are in an excellent state of repair. On the small farms, where occupants change frequently, most of the buildings are unpainted wooden structures without modern conveniences and are in poor condition. The out-buildings and barns on many farms are inadequate.

Excellent drinking water is obtained from wells. A number of gristmills are operated by water power. On many farms water power is also used to generate electricity and to supply power for other purposes.

The number of farms increased from 2,003 to 3,257 between 1880 and 1935. This is an increase of 62.6 percent. During the same period the average size of farms decreased from 132 to 71.7 acres. Land included in farms totaled 264,257 acres in 1880 and 233,493 acres in 1935. Improved land, however, increased during this period from 69,327 acres in 1880 to 92,639 acres. Almost one-half of the farms included less than 50 acres each in 1935, and three-fourths of them included less than 100 acres each. Four farms were 1,000 or more acres in size.

Tenancy increased steadily from 47.1 percent in 1880 to 64.3 percent in 1935. Several systems of rental are used. On most rented farms the tenant furnishes his own work animals and tools, three-fourths of the fertilizer used on cotton and three-fourths of the seed, and two-thirds of the seed corn and a similar proportion of the fertilizer if any is used on the corn. He receives three-fourths of the cotton and two-thirds of the corn and has the use of land for garden and forage crops, a house and outbuildings, and the use of wood lots for fuel and pasture. On a few farms the tenant furnishes all the work animals, tools, seed, and fertilizer and delivers to the landowner a fixed quantity of cotton as rent. Few tenants pay a cash rental.

Sharecroppers are furnished work animals, tools, and a small cash loan each month to be repaid when the crop is sold. The sharecropper receives one-half of the net proceeds when the crop is sold in addition to the use of the buildings on his part of the land.

The length of time that tenants and sharecroppers remain on farms varies widely. In most instances, contracts are made on a yearly basis and renewed at the end of the year. Approximately one-third of the tenants move every year, usually on January 1.

Most Negroes living on farms are in the southern part of the county. Only 159 of the 3,257 farm operators in 1935 were Negroes, and of these only 28 were owners.

Labor was hired on 558, or 19.7 percent of all farms in 1929 at total wages of \$30,690, or an average wage of \$55 per farm reporting. Both white and Negro labor is employed.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of the soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil⁶ and its content of lime and salts

⁶ The reaction of the soil is its degree of acidity or alkalinity, expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

are determined by simple tests. Drainage, both internal and external, and other external features, such as the relief, or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation are studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed pattern that they cannot clearly be shown separately on a map but must be mapped as (4) a complex. Areas of land, such as coastal beach or bare rocky mountainsides, that have no true soil are called (5) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons similar in their important characteristics and arrangement in the soil profile and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Cecil, Appling, Madison, Davidson, and Congaree are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Cecil sandy loam and Cecil clay loam are soil types within the Cecil series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character, it is generally the soil unit to which agronomic data are definitely related.

A phase of the soil type is a variation within a type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion frequently are shown as phases. For example, within the normal range of relief for a soil type, certain areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though no important differences may be observed in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, important differences may exist in respect to the growth of cultivated plants. In such an instance 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 stoniness may be mapped as phases even though these differences are not reflected in the character of the soil or in growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscella-

neous land types, in relation to roads, houses, streams, lakes, and other local cultural and natural features of the landscape.

SOILS AND CROPS

The soils of Hall County are representative of the soils of the southern Piedmont Plateau, which extends from Culpeper County, Va., to Coosa County, Ala. Hall County, however, lies near the foothills of the Blue Ridge and at a higher elevation than most of the Piedmont Plateau. This higher elevation gives the county a somewhat cooler climate and heavier rainfall than are characteristic of the lower Piedmont Plateau in Georgia. For the most part, the soils have more friable and, in places, slightly shallower or thinner subsoils over the soft disintegrated rock formations than do the Cecil soils in the central and southern parts of the State. In many places the soils are developed in rather large continuous areas, ranging in size from 1 to 5 square miles, but in other places the areas are small and somewhat scattered.

The relief of this section is that of a high plateau that has been moderately to severely dissected by streams, and most of the land is rolling to hilly, and, in places, rough and broken. Small to fair-sized areas of smooth land occur on the broad divides and ridge tops, and narrow almost level areas occupy the first bottoms bordering the streams and the second bottoms or terraces. All the upland soils are well to excessively drained, and small permanent or intermittent streams lead from every farm to natural drainageways.

Both sheet and gully erosion are moderately to severely active on most of the cultivated upland soils. Some of the more severely gullied areas are on slopes that once were cleared, farmed for several years, badly eroded, and later reforested to loblolly or old-field pines. Throughout large areas the greater part of the original sandy surface soil has been removed, exposing the red clay subsoil; in fact, most of the loamy sand or sandy loam surface soil and what little organic matter there was in the original soils have been destroyed. On thousands of acres the farmers are cultivating mainly the heavy subsoil material and only a thin sheet of the original surface layer. The once fertile and productive soils in the first bottoms have, in many places, been practically ruined for farming, because the stream channels have filled up with sand washed from the upland slopes. Some of this sandy material has spread over and buried the original dark silt loam.

Practically all of the soils are low in organic matter, and all are acid to strongly acid in reaction. The ample and well-distributed rainfall, mild temperature, and long growing season are favorable factors for the production of a wide variety of crops. These same factors, however, also promote leaching of the soluble plant nutrients and organic matter from the soils.

The physical and chemical characteristics of the soils vary widely, owing largely to the character of the parent material from which the soils have developed through natural soil-forming processes. In most places a direct relationship exists between the parent material and the soil. Some soil types and phases are mainly the products of sheet or accelerated erosion. The wide variation in relief has had some influence on the soil-forming processes. On the smooth ridge tops the soils,

in general, have deep, well-developed subsoils, whereas on the slopes the subsoils generally are thinner. At the base of some slopes colluvial-alluvial materials have accumulated to form soils that are considered valuable for agriculture. The distribution of the soil series over the county closely corresponds to the underlying rock formations.

The rock formations consist principally of granites, gneisses, schist, quartz-mica schist, and dark basic rocks. These rocks have weathered deeply, and the disintegrated and partly decomposed rock overlies the solid bedrock at a depth ranging from 20 to 80 feet. Well water for home use generally is obtained at this depth. Weathered products of granite, gneiss, and schist have formed the Cecil, Appling, Louisburg, and Worsham soils. Quartz-mica schist has given rise to the Madison soils; whereas a mixture of quartz-mica schist and mica schist has produced the Louisa-Madison soils. The old alluvial material on the terraces and second bottoms have developed into the Hiwassee, Wickham, and Altavista soils. The recent alluvial materials of the first bottoms compose the Congaree, Chewacla, and Wehadkee soils. Areas of rough broken land (Cecil-Madison soil materials) have developed on schist, gneiss, and granite. These areas include land that is too rough to be used for general farming.

A few of the more important soil series of the county are described in the following paragraphs.

The soils of the Cecil series have the widest distribution and occupy the largest aggregate acreage of any soils in the Piedmont Plateau (pl. 1, A). They occur in both large and small areas from the central part of Virginia to the eastern part of Alabama. They are characterized by their uniformly red subsoils and by their red or grayish-yellow surface soils. The Cecil soils are developed from the weathered products of granite, gneiss, and schist. These soils have only a small content of organic matter. The content of potash is high in the subsoils, in the underlying material, and in the disintegrated rock. The reaction is acid throughout.

The soils of the Appling series have a wide distribution in the southern Piedmont Plateau. They are intermediate in color between the Cecil and Durham soils. They differ from the Cecil soils primarily in color of the surface soil and subsoil, and, in many places, in the consistence of the subsoil. These soils have developed from the weathered products of granite and gneiss, and the subsoils and parent material have a high content of potash. The reaction is acid.

The soils of the Madison series differ from the Cecil soils in having a browner surface soil and more friable subsoil, and in being developed from weathered purplish-brown or purplish-red quartz-mica schist. Fine material is more abundant throughout than in the Cecil soils. These soils are most extensive in Georgia, and small areas occur in South Carolina, North Carolina, and Alabama. Small scales of mica and small fragments of the parent rock are present on the surface, and the mica content is high in the lower part of the subsoil. The smoother areas of these soils constitute some of the best lands in Georgia for the production of cotton.

The Davidson soils are readily distinguished from the Cecil soils by their darker red color throughout. They are locally known as "push land," because the soil does not scour easily from the mold-

board. Weathered products of dark-colored basic rocks, such as diorites and hornblende schist, form their parent materials. They are higher in lime and lower in potash than the Cecil soils.

The soils of Hall County have been grouped in six main classes, based on the common characteristics of the soils that could readily be observed in the field or determined by simple tests. In other words, attention has been given to those features of the soils that the farmer takes into consideration in judging the agricultural value of his land. These classes are as follows: (1) Gray sandy soils of the uplands, (2) red clay loam soils of the uplands, (3) miscellaneous soils of the uplands, (4) red to gray soils of the terraces, (5) brown to gray soils of the first bottoms, and (6) rough broken land. A graphic presentation of these soils, as regards the parent material, soil series, and brief descriptions of them, is given in the section on morphology and genesis of soils, and the agriculture practiced is discussed in considerable detail in the section on Land Uses and Soil Management.

The group of gray sandy soils of the uplands comprises Cecil sandy loam; Appling sandy loam; Madison sandy loam; Louisa-Madison gravelly fine sandy loams; Cecil sandy loam, eroded phase; Madison sandy loam, eroded phase; Appling sandy loam, hilly phase; and Louisa-Madison gravelly fine sandy loams, hilly phases.

Cecil sandy loam, Appling sandy loam, and Madison sandy loam, as typically developed, have the smoothest surfaces of the upland soils in this county, and they are naturally well drained. They contain little organic matter, warm early in the spring, are easy to cultivate, and respond readily to fertilization. The surface soils consist of light-gray, grayish-yellow, or light-brown mellow and friable light-textured sandy loam. The red or yellowish-red stiff brittle clay subsoils hold manures and have a favorable water-holding capacity. All these soils are capable of being built up to a fair or even high state of productivity, which is easily maintained by growing and turning under leguminous crops and by adding phosphorus and small quantities of potash. These sandy loams are the best soils in Hall County for the production of cotton, particularly in places where the boll weevil is prevalent.

The eroded phases of Cecil sandy loam and Madison sandy loam generally have more sloping surfaces than the typical soils and are readily distinguished from them by the spotted appearance of the field. That is, small areas of gray sandy loam, red clay loam, or brown sandy clay loam are so intricately associated that they could not be separated on a small-scale map. From 25 to 75 percent of the original sandy loam covering has been removed, and the removal of this material is not uniform over the field. The hilly phases, which occur on slopes ranging from 10 to 20 percent or more, also are not uniform in depth of the surface soil and subsoil over the soft disintegrated rock material. Here and there, and in some places over fairly large areas, the soil is comparatively shallow. These eroded and hilly phases require somewhat more care in handling, in order to conserve the soil and soil moisture, than do the typical soils.

The red clay loam soils of the uplands (the so-called red heavy lands) include Cecil clay loam; Davidson clay loam; Madison clay loam; Cecil clay loam, hilly phase; Madison clay loam, hilly phase;

and Davidson clay loam, hilly phase. These soils differ from the soils of the first group in having a red color, a heavy texture, and a high percentage of clay in the surface soils. These features give a different structure and modify the moisture conditions, or rather the quantity of rain water that is taken up by the soils. The subsoils of the Cecil and Madison clay loams do not differ greatly from the subsoils of the sandy loam soils. In fact, in many places the clay loam soils represent former sandy loams from which most of the sandy covering has been removed by sheet erosion, and the little sandy material left has been incorporated with the upper part of the subsoils through cultivation over a period of years.

The relief of Cecil clay loam, Davidson clay loam, and Madison clay loam, as typically developed, is undulating, gently rolling, or rolling, and the slope ranges from about 4 to 12 percent. These red clay loam soils are inherently strong and, where properly handled, produce good yields of corn, wheat, oats, and legumes. Davidson clay loam is considered the best soil in the southern Piedmont Plateau for the production of alfalfa.

The hilly phases of the red clay loam soils are developed on slopes ranging from 10 to 30 percent and are excessively drained. In many places the soft or hard rock material lies nearer the surface than in the typical soil.

Miscellaneous soils of the uplands comprise Mecklenburg gravelly loam, shallow phase; Louisburg sandy loam; and Worsham sandy loam. These soils occupy only a small aggregate acreage and have widely different soil characteristics. Mecklenburg gravelly loam, shallow phase, differs from typical Mecklenburg loam as mapped in other parts of the State in that the subsoil is very thin over the dark-colored hornblende schist. Scattered over the surface and mixed with the soil is a large quantity of platy hornblende schist fragments. Louisburg sandy loam has a light-gray or grayish-yellow sandy surface layer, which either grades into the light-colored soft disintegrated granite or gneiss or into a very thin friable clay or sandy clay subsoil. Worsham sandy loam is the poorest drained upland soil in the county. It is easily recognized by its position around the heads of streams and at the bases of slopes. It has a gray surface soil and a mottled gray, yellow, or whitish clay subsoil.

The red to gray soils of the terraces include Hiwassee loam, Wickham fine sandy loam, and Altavista fine sandy loam. The Hiwassee soil has a dark-brown or red surface soil and a red fairly friable subsoil. Wickham fine sandy loam differs from the Hiwassee soil in having a light-brown or brown surface soil and a yellowish-brown or reddish-brown subsoil. Altavista fine sandy loam has a gray or light-brown surface soil and a yellow subsoil. These soils have favorable surface configuration and lie above normal overflow of the streams. Hiwassee loam in most places lies at higher elevations than the other soils of the terraces. All these soils have developed from old alluvium, that is, materials washed from piedmont and mountain soils and deposited by the streams when they flowed at much higher elevations. These are good strong soils, and practically all of them are under cultivation.

The brown to gray soils of the first bottoms are Congaree fine sandy loam, Chewacla silt loam, Wehadkee silt loam, and alluvial soils (Con-

garce soil material). These soils are developed from recently deposited materials brought down by the streams from the soils in the Piedmont Plateau and the Blue Ridge. Drainage ranges from good to extremely poor. The Congaree soil is well suited to the production of corn, and the Chewacla and Wehadkee soils produce good pasture grasses.

Only one miscellaneous land type, rough broken land (Cecil-Madison soil materials), is mapped in Hall County. This classification represents a mixed condition of soils that occur in rough, broken, and steep hilly areas. The soils are not uniform in development, and their steep relief precludes their use for general farming.

The relationship of the soils to land use is discussed in a separate section. On many of the soils in Hall County the farmers recognize that there is a rather definite crop adaptation and that some soils are well suited to a certain crop, whereas the same crop might be a failure on other soils.

The present-day agriculture consists of the production of cotton and corn as the principal crops. Small acreages of wheat, oats, rye, peanuts, and a considerable acreage of hay crops are also grown. These hay crops include mainly legumes (lespedeza, crimson clover, soybeans, and cowpeas). More lespedeza is being grown each year for hay and for soil-building purposes. Sorghum, sorgo, and garden vegetables (such as cabbage, snap beans, lima beans, squashes, beets, okra, carrots, potatoes, sweet corn, turnips, collards, peppers, and kale) are grown for home consumption. Small patches of tobacco are grown for home use. Around nearly every well-established farm there are a few peach trees, apple trees, and grapevines, and in a few places there are small commercial orchards of peaches and apples. Sweetpotatoes are grown both for home use and local market. Beef cattle, poultry, and hogs bring in some cash return to the farmers and furnish meat for home consumption as well.

Cotton is the principal cash crop and forms the basis of the agriculture of the county. About one-third of the cultivated land is devoted to cotton. The soils and the climate are well adapted to the production of cotton, and, with liberal applications of fertilizer, fair yields are obtained. Cotton has been grown for a long time, and the economic welfare of the people has depended on this crop. Landowners and, more particularly, tenants know how to grow cotton better perhaps than any other crop. Even under poor methods of cultivation or under drought conditions, it produces a fair yield. Since it is not a perishable crop, it can be stored and sold at any time, and it is recognized among bankers and merchants as first-class security for loans.

Corn occupies one-half of the cultivated land and is grown on every well-drained soil throughout the county. Most of it is fed to livestock, and some is ground into meal for consumption in the home.

In the following pages the soils are described in detail, and their relation to the agriculture of the county is discussed. In the section on Morphology and Genesis of Soils are discussed those features of the soils that especially interest the student and the scientist. Table 4 gives the acreage and proportionate extent of the soils mapped.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Hall County, Ga.*

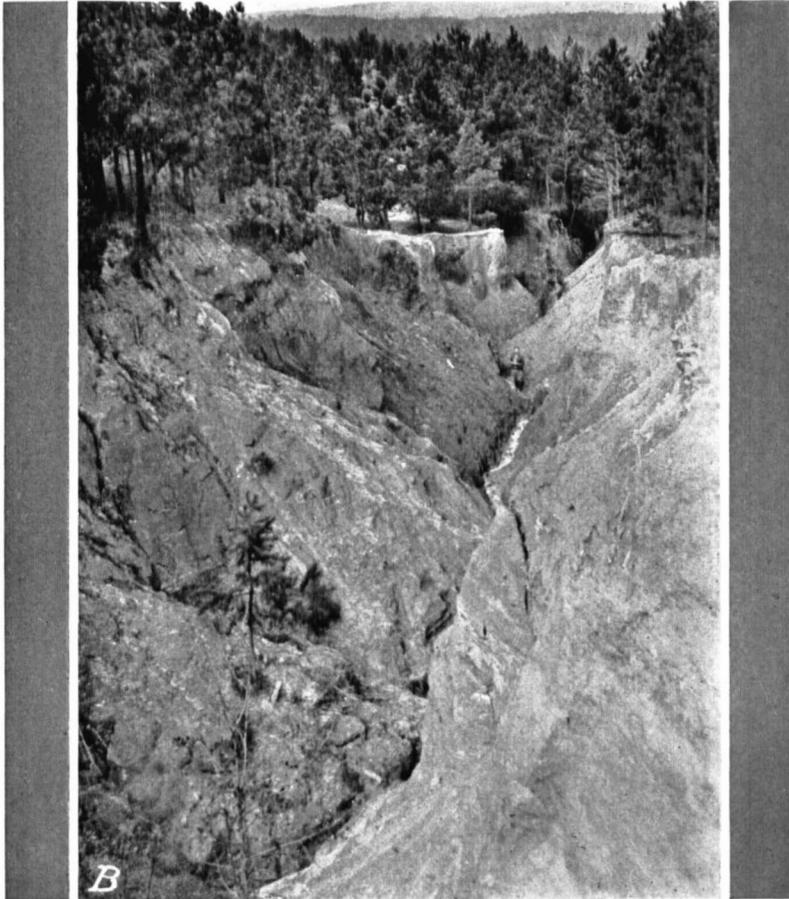
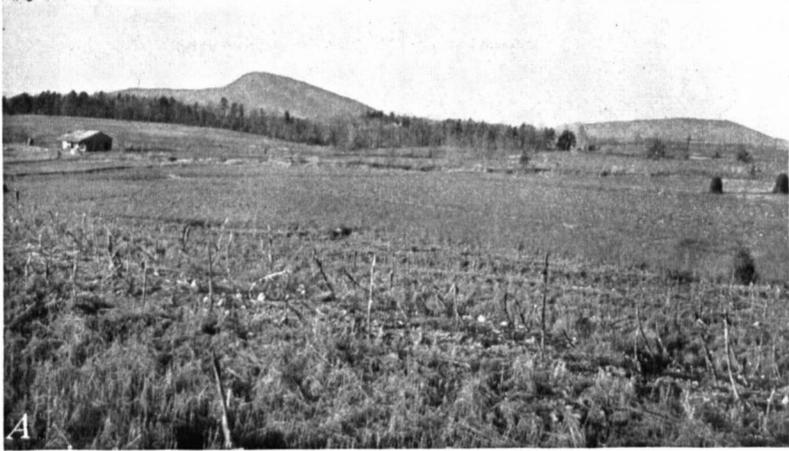
Type of soil	Acres	Per- cent	Type of soil	Acres	Per- cent
Cecil sandy loam.....	1,984	0.7	Louisburg sandy loam.....	1,536	0.6
Cecil sandy loam, eroded phase.....	25,344	9.3	Worsham sandy loam.....	896	.3
Cecil clay loam.....	28,800	10.5	Mecklenburg gravelly loam, shal- low phase.....	640	.2
Cecil clay loam, hilly phase.....	55,232	20.2	Hiwassee loam.....	192	.1
Appling sandy loam.....	13,248	4.9	Wickham fine sandy loam.....	896	.3
Appling sandy loam, hilly phase.....	16,192	5.9	Altavista fine sandy loam.....	192	.1
Madison sandy loam.....	384	.1	Congaree fine sandy loam.....	6,144	2.2
Madison sandy loam, eroded phase.....	6,592	2.4	Chewacla silt loam.....	768	.3
Madison clay loam.....	11,264	4.1	Wehadkee silt loam.....	1,472	.5
Madison clay loam, hilly phase.....	8,192	3.0	Alluvial soils (Congaree soil ma- terial).....	12,416	4.6
Louisa-Madison gravelly fine sandy loams.....	3,456	1.3	Rough broken land (Cecil-Madison soil materials).....	60,352	22.1
Louisa-Madison gravelly fine sandy loams, hilly phases.....	9,152	3.4			
Davidson clay loam.....	3,840	1.4			
Davidson clay loam, hilly phase.....	4,096	1.5	Total.....	273,280	

Cecil sandy loam.—The 5- to 8-inch surface soil of Cecil sandy loam in cultivated fields is grayish-yellow or light-brown mellow friable sandy loam. The subsoil consists of red stiff but brittle clay and extends to a depth ranging from 24 to 40 inches. This clay, when dug out of a bank, breaks into irregular-shaped lumps, which, in turn, break readily under pressure into small angular fragments. Below this layer is light-red fairly friable clay containing a considerable quantity of small scales of mica. This material grades into light-red, yellow, or brown mottled friable clayey material and soft disintegrated granite or gneiss rock.

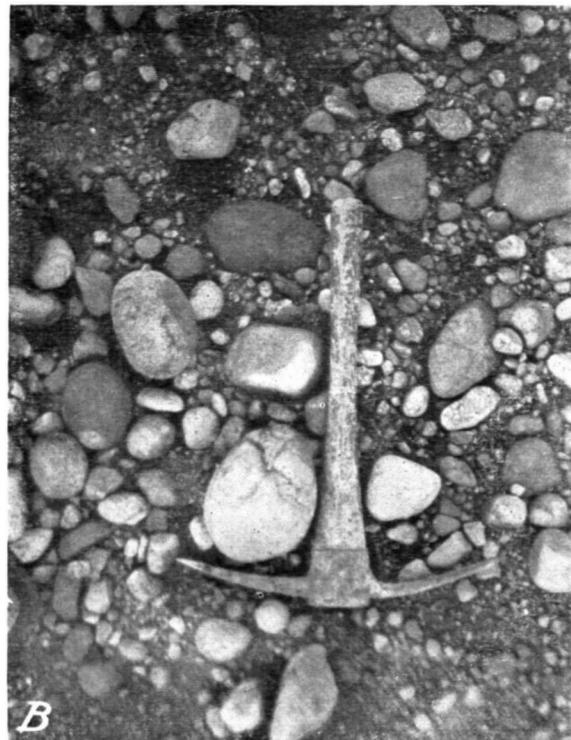
Cecil sandy loam represents the normal soil that once covered a large part of the southern Piedmont Plateau. Erosion has removed most of the original sandy surface soil in extensive areas, now classed as Cecil sandy loam, eroded phase, and Cecil clay loam.

In a few of the originally forested areas, the surface soil, to a depth of 1 to 3 inches, is dark-gray fluffy sandy loam. The dark color is due largely to the presence of organic matter. This layer is underlain by light grayish-yellow sandy loam to an average depth of 6 inches. Below this is a 2- to 4-inch layer of reddish-yellow heavy sandy loam or sandy clay. This is underlain by red stiff brittle clay, similar to that in the cultivated fields, which is hard and brittle when dry but sticky and slightly plastic when wet. White rather coarse quartz sand particles are noticeable in the red clay subsoil and throughout the soil mass. Also, small flakes of mica are present throughout the subsoil, particularly in the lower part, where the material is more friable. White angular quartz fragments from 1 to 5 inches in diameter occur here and there on the surface. In most places the hard bedrock lies from 25 to 50 or more feet below the surface, but in some places it is within a few feet of the surface.

As mapped, this soil includes small areas from which the surface soil has been partly removed, leaving the surface soil a reddish-yellow or red heavy sandy loam or clay loam. In a few spots, commonly called "galled spots," the sandy surface soil has been entirely removed, exposing the red clay loam. Where Cecil sandy loam adjoins Appling sandy loam, the subsoil is not uniformly red but partakes of the lighter color of the Appling subsoil. In many places, particularly



A, Typical scene on smoother areas of the Cecil soils (knobs of Hayesville and Porters soils of White County in background); *B*, V-shaped gully on the Cecil soils.



A, Profile of Madison sandy loam, observed 1 mile east of Flowery Branch, showing heavy upper part of the subsoil and more friable lower part; *B*, gravelly substratum under Hiwassee loam on a high terrace.

in the northern part of the county, the clay subsoils underlying Cecil sandy loam and Cecil sandy loam, eroded phase, are more friable, browner, and more shallow over the soft disintegrated material than the typical Cecil soils in the central Piedmont Plateau.

Cecil sandy loam occurs in small areas throughout the county. Some of the largest areas are in the northwestern part near Clermont and northwest of Gainesville. Two small areas are north of Jeffersonian School in the southwestern part. The surface of Cecil sandy loam is smooth, as the soil occurs dominantly on gentle slopes and in undulating areas, and the lay of the land is favorable for all kinds of agricultural operations. Natural drainage everywhere is good.

Practically all of Cecil sandy loam is cultivated, and only a few areas are in second-growth pine. This is considered one of the most desirable soils, not only in Hall County but throughout the southern Piedmont Plateau, for the production of crops common to the climate. It is easy to till and responds quickly to the use of fertilizers, barnyard manure, or green-manure crops. The clay subsoil prevents undue losses from fertilizers and manure through leaching.

Yields of cotton range from $\frac{2}{5}$ to 1 bale an acre, depending on the amount of fertilizer applied. Cotton usually receives from 200 to 500 pounds of a 3-9-3⁷ mixture. When the plants attain the proper size, a side dressing ranging from 75 to 150 pounds of nitrate of soda or sulfate of ammonia to the acre is applied. Corn yields from 10 to 25 bushels, although higher yields can be obtained by proper fertilization, adding barnyard manure, or turning under green-manure crops preceding the corn. Corn usually is given from 100 to 300 pounds of 3-9-3 fertilizer. When the corn plants are from 16 to 20 inches high, most farmers apply from 75 to 100 pounds an acre of nitrate of soda or sulfate of ammonia. Wheat yields from 6 to 15 bushels and oats from 10 to 25 bushels. These crops usually receive a liberal quantity of fertilizer in the fall and a top dressing of nitrate of soda in the spring. Sorghum, soybeans, and cowpeas yield from 1 to 1½ tons of hay an acre. In a few places, cabbages, beans, tomatoes, watermelons, and other truck crops are grown for sale. They are fertilized with 800 to 1,000 pounds an acre of a 5-7-5 mixture. Garden vegetables, small fruits, peaches, and apples give good returns on this soil.

Cecil sandy loam, eroded phase.—The eroded phase of Cecil sandy loam differs from the typical soil mainly in the variation in color and depth of the sandy surface soil and in the more sloping relief of the land. The thickness of the light-gray, grayish-yellow, or reddish-brown sandy loam surface soil ranges from 2 to 8 inches within short distances, with here and there many small areas of red or reddish-brown clay loam or sandy clay loam. Clean-cultivated fields present a very spotted appearance, because of the numerous areas of red sandy clay loam within areas of gray sandy loam. The individual red or reddish-brown sandy clay loam or clay loam spots commonly are referred to as galled spots. The variations in the texture and depth of the surface soil are the result of sheet erosion.

⁷ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

From 25 to 75 percent of the original sandy surface soil has been removed. Erosion is more active on this soil than on the typical soil because the surface is more sloping or rolling.

Included with this soil as mapped, especially about 2 miles northwest of Gillsville along the eastern county line, the surface soil is dark grayish brown and the subsoil is red friable sandy clay containing only a small quantity of mica. Here, the subsoil is distinctly more friable and more sandy than elsewhere. At a depth of 10 feet or more the underlying soft rock consists of hornblende-epidote schist containing considerable pyrite and only a small quantity of mica. A few quartz fragments are present here and there. In many places it was difficult to draw boundaries between areas of Cecil sandy loam, eroded phase, and Cecil clay loam.

Because it is extensive, Cecil sandy loam, eroded phase, is an important agricultural soil. It is widely distributed in both large and small areas in all parts of the county, particularly in the northwestern and eastern parts. It is closely associated with Cecil sandy loam and Cecil clay loam, and before it underwent serious sheet erosion it had a 6- or 8-inch sandy surface covering. Unless sheet erosion is prevented, all this eroded soil eventually will become Cecil clay loam or Cecil clay.

Drainage everywhere is good to excessive. Although the land is gently to moderately sloping or rolling, it lends itself, in most places, to the building of terraces and proper seeding and handling.

Practically all of this soil has been cleared and farmed. In many places the more severely eroded areas have been abandoned and have grown up to old-field pine. In some places gullies have formed (pl. 1, *B*). This soil is not so easy to cultivate as is typical Cecil sandy loam, owing to the wide differences in texture of the surface soil within each field and, in some places, even within 1 acre. The same crops are grown as on Cecil sandy loam, but the yields in many places are slightly lower under the same cultural treatment and fertilizer practices. Terracing and the growing of cover crops are recommended to protect this soil from further erosion.

Cecil clay loam.—The topmost 5 to 8 inches of Cecil clay loam, locally known as red land, consists of red or reddish-brown clay loam or heavy sandy clay loam. This material grades into the typical subsoil, which is red, stiff but brittle clay under normal moisture conditions. When dug out it breaks into large irregular-shaped lumps, which can be broken with the hand into small angular fragments. This clay is slick and sticky when wet. In most places, at a depth ranging from 30 to 40 inches, the heavy clay merges into lighter red friable clay containing numerous small mica flakes. This material grades, below a depth ranging from 6 to 8 feet, into light-red, mottled with yellow, brown, and gray, soft very friable disintegrated fairly well decomposed rock material that contains a small quantity of clay and many small mica flakes. In many places the unweathered or hard bedrock of granite or gneiss is reached from 25 to 30 feet below the surface. In some places, where the underlying rock is granite, the depth of weathering is very irregular and the hard rock lies only a few feet below the surface. This condition is most common in the northern and western parts of the county. In the eastern part the parent rock of Cecil clay loam has a high content of mica. Most of

the clay loam has developed through sheet erosion from the sandy loam.

Almost white or brown-stained small angular quartz fragments, ranging from 1 to 5 inches in diameter, are scattered over the surface in some places. They are more noticeable in cultivated fields, but in few places are they numerous enough to interfere with farming operations. Distinctly gravelly areas including 5 or more acres are indicated on the soil map by gravel symbols. Included in the mapping of Cecil clay loam are patches of shallow sandy loam too small to be separated on a small-scale map. Along the county line, about 2 miles northwest of Gillsville, a few areas are included in which the subsoil is more friable than in typical Cecil clay loam.

Cecil clay loam is one of the most extensive agricultural soils in the county. It is widely distributed, generally in close association with Cecil sandy loam and Cecil sandy loam, eroded phase. The largest areas are in the northwestern, western, and southeastern parts. The relief ranges from undulating and gently sloping to rolling. Many areas have a fairly smooth surface, particularly on the ridge tops, and are surrounded by Cecil clay loam, hilly phase. In some places it is difficult to draw boundaries between Cecil clay loam and Cecil clay loam, hilly phase, as they grade imperceptibly into each other.

A large part of Cecil clay loam is or has been cleared of its original tree growth. Some of the cleared land was farmed for many years, became eroded, was abandoned, and has since grown up to second-growth shortleaf pine together with some hardwoods, mainly white oak and red oak. Broomsedge, blackberry briers, and green-brier cover some of the recently abandoned or idle land. A considerable acreage is in Bermuda grass sod.

Perhaps not more than 60 percent of this soil is under cultivation. Of the land under cultivation, about 40 percent is devoted to cotton, 40 percent to corn, and the rest to cowpeas, soybeans, small grains, and garden vegetables. Cotton yields from two-fifths to four-fifths of a bale an acre, when fertilized with 200 to 400 pounds of a 3-9-3 fertilizer or a home mixture of 4-10-4. Usually the cotton receives a top dressing of 100 pounds of nitrate of soda or a similar application of sulfate of ammonia. Corn yields from 10 to 25 bushels when it receives from 100 to 200 pounds of 3-9-3 and a side dressing of 100 to 150 pounds of nitrate of soda or sulfate of ammonia. Wheat yields from 6 to 15 bushels, and oats from 10 to 30 bushels. These crops usually are given an application of 100 to 150 pounds of 3-9-3, or, in some instances, phosphoric acid alone is applied at the rate of 200 to 300 pounds to the acre. Early in spring an application ranging from 100 to 150 pounds of nitrate of soda to the acre is applied to the wheat and oats. Sorghum and other hay crops yield from 1 to 2 tons an acre and generally receive from 100 to 200 pounds of 3-9-3. *Lespedeza sericea* does well on this soil. After the first year the roots form a dense sod that very effectively prevents erosion. Two cuttings of hay, or one cutting of hay and a crop of seed, can be obtained each year. Yields of lespedeza hay range from 1 to 2 tons an acre, depending on the condition of the land and the treatment given it. Some farmers apply from 1,000 to 2,000 pounds of lime and 100 pounds of triple phosphate an acre.

Terracing is required on most areas of Cecil clay loam, in order to control run-off and check gully erosion. For the most part the surface is favorable for the construction of terraces. Terraces, together with strip crops and Bermuda grass sod, are highly recommended for holding and improving this soil. Cecil clay loam is naturally a strong soil, capable of being built up to a fair or high state of productivity, which is easily maintained by growing leguminous crops in the rotation. Management of this soil requires stronger work animals and heavier machinery than management of Cecil sandy loam. Prior to the advent of the boll weevil, Cecil clay loam was considered one of the most desirable soils in this county for the production of cotton. Cotton matures later on this soil, and the damage from boll-weevil infestation is greater in most years than on the light-textured sandy loam.

Cecil clay loam, hilly phase.—This soil differs essentially from typical Cecil clay loam in that it has steep, hilly, and broken relief. The slopes range from 8 to 25 percent in gradient. Owing to the steepness of the land, the texture and depth of the surface soil and subsoil vary more widely than in the clay loam. As a rule, the depth to disintegrated rock is less than in that soil. In some virgin areas the surface soil is dark-gray or grayish-brown sandy loam, and this represents the original condition of the surface soil in the forested areas.

This soil is widely distributed, generally in close association with the typical soil. Large bodies occur throughout the county, especially in the west-central part, and aggregate large total areas. Owing to its relief, all this hilly soil is well to excessively drained. Long-cultivated areas have undergone much sheet erosion and in many places severe gullying. In many places the entire surface soil and part of the subsoil have been removed and the heavy clay is exposed. Some of the areas once under cultivation and later abandoned have now grown up to old-field pine. In some such areas the vegetative cover has arrested erosion.

About 25 percent of this soil is under cultivation and 25 percent in Bermuda grass pasture. The rest is in second-growth or old-field pine or represents recently abandoned fields and is covered with broomsedge, briars, plum bushes, and small pines. Yields vary considerably on the cultivated areas, depending on the lay of the land, cultural methods, and fertilizer applied. On some of the more gently sloping areas that have been carefully managed, yields approach those obtained on typical Cecil clay loam. The cost of farming such areas, however, is much greater than for areas of Cecil clay loam. Control of erosion is difficult. Some of the more gently sloping areas can be terraced successfully. Bermuda grass furnishes excellent pasture for cattle and prevents sheet erosion and gullying. The steeper areas and badly gullied areas should be used for forestry.

Appling sandy loam.—The 6- or 8-inch surface soil of Appling sandy loam in cultivated fields, when dry, is light-gray or grayish-yellow mellow friable light sandy loam or sandy loam. It is underlain to a depth of about 12 inches by grayish-yellow or yellow friable sandy loam. This grades into a 2- to 4-inch layer of deep-yellow, light-red, or reddish-yellow heavy sandy loam or light-textured sandy clay. The subsoil is yellowish-red or yellowish-brown stiff but brittle clay, which

passes, at a depth ranging from 20 to 24 inches, into streaked or banded red, yellow, and light-gray stiff but brittle clay. Below a depth of 30 or more inches is a 10- to 20-inch layer of mingled light-yellow, light-red, and gray hard but brittle clay that is more friable than the overlying material. This grades into mottled red, yellow, dull-brown, and white soft disintegrated partly decomposed granite or gneiss. In virgin areas the topmost 2 or 3 inches of the surface soil is darkened by organic matter.

In places erosion has removed a part of the surface layer or has exposed the reddish-yellow subsoil. The thickness of the surface soil varies considerably, owing to erosion, ranging from a few to 20 inches. The thicker sandy covering generally occurs on the lower slopes, or at the base of the steeper slopes. Angular quartz fragments, and, in some places, fragments of granite are present over the surface and throughout the soil. In a few areas the texture of the surface soil is fine sandy loam. In some places a brownish-yellow clay subsoil grades into the disintegrated rock at a depth ranging from 30 to 40 inches. In the northeastern part of the county are a few small areas of grayish-yellow silt loam underlain by highly micaceous loam. This inclusion would be mapped as York silt loam if it were extensive enough to separate on a map of the scale used. Such an area occurs three-fourths of a mile northwest of Bethlehem Church. East of Clermont there is another variation, in which the surface soil contains a noticeable quantity of coarse sand and the subsoil is yellow stiff sandy clay that grades below a depth of 24 inches into yellow, mottled with gray and brown and streaked with red, clay or sandy clay. This is Durham sandy loam, but it is included with Appling sandy loam because of its small extent.

Many areas of Appling sandy loam are scattered throughout the county. The largest ones are in the extreme eastern part northwest and southwest of Gillsville and in the southern part near Roberts Cross Roads. Most of the land has a gently sloping to moderately rolling relief. In some places the surface is fairly smooth, as the soil occurs on the broad interstream divides. Natural drainage everywhere is good.

Appling sandy loam is a rather important agricultural soil. About 75 percent of it is under cultivation, a small part is in pasture, and the rest is forested largely with old-field pine and shortleaf pine. Approximately 40 percent of the cultivated soil is used for the production of cotton, yields of which range from one-third to four-fifths of a bale to the acre. The land for cotton receives from 300 to 400 pounds of 3-9-3 fertilizer an acre, supplemented by a side dressing of 100 pounds of nitrate of soda. Corn is the next important crop, and land for this crop usually is fertilized with a lighter application of commercial fertilizer than cotton, and side dressed with nitrate of soda or sulfate of ammonia. Corn yields from 8 to 20 bushels an acre, depending on fertilization, the system of rotation practiced, and the condition of the soil. Small grains and some cowpeas and soybeans are grown for hay. On one farm a rotation of cotton, small grain, and lespedeza is maintained. Sweetpotatoes and garden vegetables do well on this soil. In North Carolina, Appling sandy loam is considered one of the good soils for the production of bright-leaf tobacco.

Appling sandy loam is one of the first soils that can be worked immediately after rains. Cotton matures earlier on this soil than on the heavier textured red soils. The soil is badly leached, but it responds well to the application of fertilizers and manure and to the turning under of green-manure crops.

Appling sandy loam, hilly phase.—The hilly phase is separated from typical Appling sandy loam because of its much steeper relief and its lack of uniformity in both the surface soil and the subsoil. In some places, however, the surface soil and subsoil are similar to the corresponding layers of typical Appling sandy loam, especially in a few of the smoother areas that are too small to be separated on the map. Included in mapping are a few bodies of Louisburg sandy loam, hilly phase, that are too small to show legibly on a small-scale map. The Louisburg soil has a light-gray surface soil that grades into the light-colored disintegrated granite.

Appling sandy loam, hilly phase, has its greatest development in the southern part of the county southwest and southeast of Flowery Branch. Areas occur in various parts of the county.

In general, the slope of this hilly soil ranges from 8 to 20 or more percent. Southeast of Gainesville near Pool School this soil occupies long steep slopes. Near Piney Grove School east of Flowery Branch it occupies narrow ridge tops as well as long slopes.

All this soil is well to excessively drained. Although sheet erosion has been active in many places, only a few gullies have formed. It is difficult to maintain terraces on the steeper parts of the land. Extensive areas that formerly were cultivated are now lying idle.

Probably 30 percent of this soil is under cultivation. Near Piney Grove School a higher percentage of the soil is under cultivation than in other parts of the county. In this location there are only small acreages of soils better suited to the production of cotton, corn, and other crops. The same crops are grown as on the typical soil, but yields are slightly lower even under the same cultural methods. A small proportion of the land is in Bermuda grass pasture. The greater part is in second-growth or old-field pine and abandoned fields.

Madison sandy loam.—The surface soil of Madison sandy loam, to a depth of 8 or 10 inches, consists of light-brown or grayish-brown sandy loam. The subsoil is red fairly friable clay that readily breaks into a fine mealy mass under favorable moisture conditions. It is more friable than the corresponding layer in the Cecil soils (pl. 2, A). Very little mica is visible in this layer, except in a few areas. Generally below a depth of 18 or 20 inches the subsoil consists of light-red or red friable clay containing a large quantity of finely divided mica flakes. In most places the purplish-red soft disintegrated quartz-mica schist lies from 40 to 50 inches below the surface; in many places, however, it comes within 1 or 2 feet of the surface. Small angular quartz fragments and small platy fragments of quartz-mica schist are scattered over the surface in many places.

The color of the soil ranges from yellowish gray to brown or reddish brown, the latter color becoming more pronounced as increased quantities of the red subsoil are mixed with the surface soil by tillage. The depth of the surface soil ranges from 4 to 15 inches. In some places the red friable clay upper subsoil layer is thin and

the greater part of the subsoil is friable micaceous clay. The soil in such areas resembles the Louisa soils. In other places the subsoil, particularly where the soil adjoins the Cecil soils, is red stiff clay containing coarse quartz sand.

Madison sandy loam is a very inextensive soil. Only a few small areas are scattered here and there, mainly near Clermont and in the west-central part of the county. The relief ranges from undulating to gently sloping and gently rolling. Both surface and internal drainage are good. Owing to its favorable surface features and friable consistence, it is not so susceptible to sheet erosion as Cecil sandy loam on similar slopes and under the same cultural treatment.

This soil is highly prized for the production of cotton, and it is also rated highly for the production of other farm crops common to this climate. Yields of cotton range from $\frac{1}{2}$ to 1 bale an acre, and even higher yields are obtained through the use of heavy applications of fertilizer and manure. Cotton receives from 200 to 400 pounds of 3-9-3 or 4-12-4 fertilizer to the acre. Corn yields from 15 to 30 bushels an acre, wheat 8 to 15 bushels, oats 10 to 30 bushels, and sorghum and other hay crops $1\frac{1}{2}$ to $2\frac{1}{2}$ tons of hay. About the same fertilizers are applied for these crops as on Cecil sandy loam. Some truck crops, such as tomatoes, cabbage, string beans, and watermelons, are grown. These crops generally are fertilized with 500 to 1,000 pounds of 5-7-5. Soybeans, cowpeas, and garden vegetables are grown successfully. Most of this soil is under cultivation; the rest is in small wood lots or pasture.

Madison sandy loam, eroded phase.—This soil differs essentially from typical Madison sandy loam in the lack of uniformity of the texture and thickness of its surface soil. It represents the condition developed on typical areas of Madison sandy loam after the land was cleared and cultivated. Sheet erosion has removed part or all of the surface soil, exposing the red clay subsoil in spots. Between 25 and 75 percent of the original surface soil has been washed away. The different textures and colors of the surface soil give the fields a spotted appearance.

The largest areas are south of Clermont and in the vicinity of Gainesville, and many smaller bodies are scattered throughout the county. The relief is dominantly gently sloping to gently rolling; a few small areas are almost level, and a few are distinctly rolling. Natural drainage everywhere is good. In most places this soil requires closer spacing of terraces than does typical Madison sandy loam.

Nearly all of the land is under cultivation to crops similar to those grown on the typical soil, but yields in some instances are slightly lower. About the same crops are grown, the same cultural methods are practiced, and the same fertilizers are applied on the two soils.

Madison clay loam.—In cultivated fields, the surface soil of Madison clay loam, to a depth of 6 to 8 inches, is red or brownish-red friable clay loam. In forested areas the topmost few inches of the soil is brown fine sandy loam, owing to the presence of organic matter. The surface soil is underlain to a depth of 18 to 20 inches by moderately friable red clay that breaks down readily under normal moisture conditions into fine particles or crumbs. Below this is light-red friable clay or clay loam containing a large quantity of small mica scales. This material has a slick greasy feel. It merges into light-red friable

soft micaceous clay mixed with disintegrated soft quartz-mica schist. Originally this soil had a covering of fine sandy loam or sandy loam in most places, but this material has been removed through sheet erosion.

Small mica scales are seen on the surface in most places, and small quantities are present in the subsoil. In the western part of the county many small areas have a yellowish-brown surface soil and a yellowish-red or light-red clay subsoil. Here, the soil mass contains more coarse quartz sand than typical Madison clay loam and the mica flakes are relatively small and inconspicuous.

Some of the largest areas of Madison clay loam are between Flowery Branch and Gainesville, and many small areas are widely distributed. This soil is developed on gentle to moderate slopes and in gently rolling areas. All the land is naturally well drained. Sheet erosion has been active, but gullies are fewer than on Cecil sandy loam having the same relief. Plant roots readily penetrate both the surface soil and the subsoil. The water-holding capacity is rather high.

This soil is used mainly for the production of cotton, corn, wheat, oats, sorghum, and other hay crops. Good pastures, consisting of Bermuda grass and lespedeza, together with some Dallis grass, are maintained on this soil near Clermont. Cotton yields from one-third to three-fourths of a bale to the acre where given an application of 200 to 400 pounds of 3-9-3 fertilizer. Corn produces from 15 to 30 bushels an acre, wheat 8 to 15 bushels, oats 10 to 30 bushels, and sorghum and other hay crops $1\frac{1}{2}$ to $2\frac{1}{2}$ tons. Some winter legumes, such as Austrian Winter peas, crimson clover, and vetch, are grown to a small extent. Land for these crops is given from 300 to 400 pounds of basic slag or 200 pounds of acid phosphate to the acre, together with a liberal quantity of ground limestone. Most of the land is or has been cultivated. The abandoned areas are grown up to old-field or shortleaf pine, and in many places these fields show more sheet erosion and gullies than those now under cultivation. This is a good strong soil and is capable of being built up to a fairly high state of productivity.

Madison clay loam, hilly phase.—This soil differs essentially from typical Madison clay loam in that it is developed on steep slopes or hilly areas and the profile development is not so uniform. In many places the subsoil layer is shallow over the soft disintegrated quartz-mica schist or mica schist. In some places the surface soil is very thin and is brown or reddish-brown heavy clay loam. In other places it is deeper and is grayish-brown fine sandy loam. Included in mapping also are small areas of Louisa-Madison gravelly fine sandy loams, hilly phases.

Some of the largest areas of this soil are southwest of Gainesville, northeast of Gainesville, and south of Chestnut Mountain. The relief is steeply sloping or hilly, and the slope ranges from 8 to 25 percent, with the most common gradients ranging from 12 to 20 percent. Drainage is good to excessive. Both sheet and gully erosion are pronounced on the steeper areas that have been under clean cultivation for a considerable time.

About 20 percent of this land is cultivated, about 20 percent is in Bermuda grass pasture, and the rest is in abandoned fields and second-growth pine. A few abandoned fields southeast of Gainesville

have been planted with loblolly pine. On some of the smoother areas that have been carefully managed and protected from serious erosion, crop yields compare with those obtained on typical Madison clay loam under the same fertilization and cultural methods. Over most of the cultivated areas, however, yields are low. The cost of producing crops on this hilly land are higher than on the typical soil. Much of the land should be seeded for pasture or used for forestry, because erosion will be severe on clean-cultivated fields.

Louisa-Madison gravelly fine sandy loams.—Louisa-Madison gravelly fine sandy loams represent a soil complex consisting of Louisa gravelly fine sandy loam and Madison gravelly fine sandy loam and occurring in such small and intimately associated areas that the individual types cannot be separated on a map of the scale used. The areas of Louisa gravelly fine sandy loam have brown, grayish-brown, or, in some places, reddish-brown fine sandy loam or loam surface soils containing some angular quartz gravel and fine fragments of mica schist. A large quantity of mica is scattered over the surface and mixed with the soil. The subsoil is light-red friable micaceous clay with a smooth greasy feel. Areas of Madison gravelly fine sandy loam have a soil profile similar to that of the typical Madison soils. The Madison and Louisa soils differ in that the subsoils of the latter are red fairly friable clay in the upper part and friable micaceous clay in the lower part.

Throughout the greater part of this complex the gravel does not interfere seriously with cultivation. Fragments of quartz-mica schist and mica schist are present in some areas. In many places the soft disintegrated mica schist or schist is near the surface. Small areas of Madison clay loam southeast of Flowery Branch and in a few other locations are included with this complex in mapping. Another inclusion is 1 mile southeast of Flowery Branch on a narrow ridge top. Here, the soil is developed from quartzite, but its area is too small to warrant separation on a small-scale map. Rock outcrops are numerous in this inclusion. The ridge top ranges in width from 100 to 300 feet, is approximately 1 mile long, and breaks off rather abruptly on the south, with a drop of as much as 100 to 200 feet in some places to the lower lying country.

Louisa-Madison gravelly fine sandy loams occur in several small areas. Most of them are scattered throughout a belt from 6 to 8 miles wide that roughly parallels United States Highway No. 23 south of Gainesville and United States Highway No. 129 north of Gainesville. Most of this soil has gently sloping to moderately hilly relief. Drainage is everywhere good to excessive.

Only a small proportion of this soil is under cultivation. Most of it is forested to second-growth or old-field pine or is in abandoned fields that have grown up to broomsedge, briars, plum bushes, and small pines. A few areas are in Bermuda grass. The soil has a comparatively low agricultural value, as in many places the underlying rock, because it lies so near the surface, restricts the development of roots and makes the soil droughty. Small yields of cotton, corn, oats, and sorghum hay are obtained. Patches of this soil that have a fairly good subsoil produce yields comparable to those obtained on the Madison soils. The best use for Louisa-Madison gravelly fine sandy loams is for Bermuda grass pasture or forestry.

Louisa-Madison gravelly fine sandy loams, hilly phases.—These hilly soils have their greatest development in the southwestern part of the county. The largest areas are northeast of Jeffersonian School and west of Flowery Branch; and areas are southwest of Clermont in the northern part. Smaller bodies are scattered here and there throughout the central and southern parts.

These soils are separated from Louisa-Madison gravelly fine sandy loams because of their steep slope and shallowness of surface soil and subsoil. They are closely associated with the Louisa-Madison soils complex. In eroded areas the surface soil is red loam or clay loam carrying numerous fragments of quartz-mica schist or gneiss. On some of the steeper slopes, knolls, and ridges, the underlying quartz-mica schist and schist are only a few inches below the surface. These hilly soils are well to excessively drained, owing to the steep slope, which ranges from 8 to 25 or more percent. Areas that have been under clean cultivation have lost a large part of the original surface soil and in some places a part of the subsoil.

Approximately 20 percent of this soils complex was once under cultivation, and the greater part of it is now in abandoned fields or permanent Bermuda grass pasture. Probably not more than 5 percent is under cultivation. A few small areas here and there can be farmed successfully under a suitable crop rotation and the construction of terraces. Such areas, when properly fertilized and handled, produce good yields of cotton, but moisture conditions are not so favorable for the growing of corn. Bermuda grass does well. Shortleaf pine constitutes the principal tree growth in most places.

Davidson clay loam.—The 5- to 8-inch surface layer of Davidson clay loam consists of brownish-red or reddish-brown clay loam. It grades into a layer of brownish-red heavy clay loam, a few inches thick. The subsoil is deep-red or maroon smooth heavy clay or silty clay and, below a depth ranging from 40 to 50 inches, it becomes lighter red and slightly friable. At a depth of 50 to 60 inches the material passes into dark-red, yellowish-brown, and black soft friable decomposed rock—either hornblende schist or diorite. In a few places small boulders or fragments of the parent rock and of quartz are scattered over the surface.

Included with this soil as mapped are a few small areas in which the surface soil is heavy clay or brown loam. Also included are a few areas with a reddish-brown heavy silty clay loam surface soil and a subsoil containing a noticeable quantity of small mica scales. In some places where this soil adjoins the Cecil or Madison soils the underlying rocks are both acidic and basic. Here the soil is similar to the Lloyd soil developed elsewhere. Such areas are 2 miles southeast of Bethel Church in the northwestern part of the county and near Candler in the southeastern part.

Typical Davidson clay loam occurs in numerous areas in the southeastern, eastern, and extreme northern parts of the county. The largest areas are southwest of Belmont.

Areas of Davidson clay loam are almost level to moderately sloping or gently rolling. Practically all of this soil lies favorably for agricultural purposes. On comparable relief, this soil does not erode so easily as does Cecil clay loam, but there is considerable sheet erosion. Where gullies have formed, they have rounded shoulders, as con-

trusted with the V-shaped or cave-type gullies in Cecil clay loam. All of the Davidson soil is naturally well drained. Owing to its heavy texture, water does not penetrate it so readily as it does the light-textured sandy soils.

About 90 percent of this soil is under cultivation. It is considered an excellent soil for the production of corn, wheat, cotton, clover, and alfalfa. Bermuda grass also does well. It is reported that cotton matures a little later on this soil than on sandy soils and is therefore more frequently damaged by the boll weevil. Cotton yields from two-fifths to four-fifths of a bale to the acre. Land for this crop receives from 250 to 350 pounds of a 4-10-4 fertilizer to the acre and usually a liberal application of nitrate of soda. Corn yields from 20 to 45 bushels, with the addition of 200 to 300 pounds of 4-10-4. It also receives 100 pounds of sulfate of ammonia as a side dressing. Velvetbeans or cowpeas frequently are planted in the rows with the corn. Only small acreages are devoted to the production of wheat and oats. Wheat yields from 8 to 18 bushels an acre, and oats from 12 to 40 bushels. Land for these two crops receives a liberal application of fertilizer at the time of sowing. Soybeans and cowpeas produce from 1½ to 2 tons of hay an acre. Some alfalfa is grown, and usually from 3 to 5 cuttings of hay are obtained each year from well-established stands, with a total acre yield of 2 to 4 tons. Alfalfa is seeded with a nurse crop of small grain. Good stands of alfalfa can be obtained where the seedbed has been thoroughly prepared and, in addition, from 3 to 4 tons of ground limestone and 300 pounds of superphosphate per acre are added. This is followed by an annual application of phosphate or triple phosphate.

Davidson clay loam can be built up to a high state of productivity through proper soil management, and large yields of small grains, clover, and alfalfa can be obtained. Peaches do well on this soil, and their color and flavor are especially good.

Davidson clay loam, hilly phase.—This hilly soil occurs for the most part in close association with typical Davidson clay loam. It differs from the typical soil in that the profile is not so uniform, owing to severe sheet erosion in some places and also to the fact that the soil developed on steeper relief. In many places sheet erosion has removed all the original surface soil and part of the subsoil. Most of the soil occurs in the southern and southeastern parts of the county, mainly in small areas.

This soil occurs on steep slopes, hillsides, and a few isolated ridges and knolls. The slope ranges from 12 to 25 percent. The land is excessively drained in many places. Areas formerly under clean cultivation are gullied.

The greater part of the land supports a mixed growth of oak and pine, and some of the formerly cultivated areas have reforested to second-growth pine. Under proper management, most of this soil could be utilized profitably for the production of kudzu and lespedeza, which furnish good pasturage for cattle. The steeper and more eroded areas should be devoted to forestry.

Louisburg sandy loam.—Louisburg sandy loam differs from Appling sandy loam chiefly in that it has no well-developed subsoil. The largest area is northwest of Gainesville surrounding the Riverside Military Academy. A few bodies too small to delineate on a

small-scale map are included with the Appling soils. The 8- to 12-inch surface soil consists of light-gray or grayish-yellow sandy loam, coarse sandy loam, or loamy sand, that is almost white under very dry conditions. This grades into a layer, only a few inches thick, of brownish-yellow or slightly reddish yellow friable sandy loam, heavy sandy loam, or sandy clay, and this, in turn, gives way to light-colored soft disintegrated granite. In many places the surface soil grades imperceptibly into the disintegrated soft granite or gneiss, whereas in other places a thin layer of reddish-yellow or yellowish-brown clay intervenes, approaching in its characteristics the subsoil of the Appling soil. Outcrops of both soft and hard rock are common. In wooded areas the first inch or two of the surface soil is slightly darkened by the presence of organic matter.

This soil occupies knobs, ridges, and sloping and hilly areas. Drainage is excessive in both the surface and subsurface layers. The soil is droughty in character and susceptible to considerable sheet erosion.

Only a small part of this soil is under cultivation. Some formerly cultivated fields have been abandoned, and a few support a growth of oaks and shortleaf pine. A sparse growth of broomsedge, briers, and bushes covers the idle land. Some garden vegetables are grown, in addition to some cotton and corn. The best use for the greater part of this soil, however, is for building sites or forestry.

Worsham sandy loam.—This soil occurs in very small widely scattered bodies, mainly in association with the Appling soils but to some extent with the Cecil soils. It presents a conspicuous feature of the landscape. Its principal position is around the heads of streams, or bordering streams or intermittent drainageways. Some of the largest areas are north of Flowery Branch.

The land is nearly flat or slopes gently toward the small drains. It is poorly drained and seepy and contains wet-weather springs. Much of it lies at the base of the slopes, where it receives the surface water from the higher areas. The soil has developed under waterlogged conditions.

The 5- to 12-inch surface soil is gray or yellowish-gray sandy loam, and the subsoil is steel-gray or bluish-gray clay with streaks and mottles of yellow and rust brown. In some places the subsoil is nearly white when dry and consists of silty clay, which is used locally for whitewashing. In some places a thin layer of brown or reddish-brown loam or clay loam covers the surface and represents colluvial material washed from areas of the Cecil soils. The texture of the surface soil varies; in some places it is fine sandy loam and in other places loam or clay loam.

Practically none of this land is cultivated. A few of the small better drained areas are used for the production of sorgo and corn. It supports excellent pasture, especially if seeded to a mixture of Bermuda, carpet, and Dallis grasses. Locally, a few gullies have eaten back from the streams or drainageways. A few trees scattered here and there in the pasture are beneficial, as they take up some of the excess moisture and furnish shade for cattle.

Mecklenburg gravelly loam, shallow phase.—Mecklenburg gravelly loam, shallow phase, varies greatly in thickness of the subsoil over bedrock and in the quantity of small platy fragments on the surface. The surface soil is brown or dark-brown friable loam or

heavy sandy loam, from 4 to 6 inches thick. The subsoil is reddish-brown or yellowish-brown heavy clay loam or clay, slightly tough and yet moderately plastic. It extends to a depth of 10 to 20 inches, where, in some places, there is a thin layer of mottled gray, green, and brown heavy sandy loam. This material grades into dark-green, mingled with yellow, soft disintegrated hornblende schist. Scattered over the surface and through the soil is a large quantity of small platy fragments, ranging from one-eighth to one-half inch in diameter, of hornblende schist, and a few ranging from 3 to 8 inches in diameter. In some places these platy fragments and stones occur in sufficient quantities to interfere with cultivation. A noticeable quantity of quartz sand is present throughout, and apparently the hornblende schist is of coarser texture than that generally giving rise to the Mecklenburg soil.

Included with Mecklenburg gravelly loam, shallow phase, are a few small spots of a soil approaching Davidson clay loam in color and other characteristics. Also included are areas of Iredell loam or Iredell sandy loam that are too small to show separately on the map. These areas have a grayish-brown or brown surface soil and a brownish-yellow, mottled with gray, heavy sticky plastic clay subsoil. The underlying hornblende schist is reached at a depth of about 20 inches.

The small bodies of Mecklenburg gravelly loam, shallow phase, occur chiefly near Duagan Chapel, and aggregate a small total area. Most of this soil is developed on rather high ridges, where the relief generally ranges from gently rolling to rolling, but it also includes some fairly smooth areas on the broader ridge crests and some steep slopes comprising the breaks to the lower lying soils.

Approximately 30 percent of this soil is in corn, 20 percent in cotton, and 10 percent in small-grain and hay crops. The rest is in abandoned fields or is grown up to second-growth pine or oak. The land for corn is fertilized with 100 pounds of 3-9-3 to the acre at planting time and later is given a side dressing of 100 pounds of sulfate of ammonia. Acre yields of corn range from 15 to 25 bushels. Cotton yields about two-fifths of a bale to the acre. The land for this crop ordinarily is fertilized with 200 pounds of 3-9-3 to the acre. Small grains and hay crops give fair yields on the better areas of this soil. Prior to the advent of the boll weevil this was considered a desirable soil for the production of cotton, as the later maturing varieties returned good yields.

Hiwassee loam.—Hiwassee loam is the reddest soil occurring on the second bottoms and terraces. The land ranges from almost level to gently sloping and lies well for the use of improved machinery. This soil occupies a high position on the older terraces in a few areas along the Chattahoochee River south of South Bend Church and east of United States Highway No. 129. All the land is naturally well drained and, if properly handled, is subject to only slight sheet erosion.

The surface soil, to a depth of 6 or 8 inches, is dark-brown mellow friable loam. This grades into dark-red or reddish-brown loam or light clay loam, which at a depth of 12 or 14 inches is underlain by dark-red rather heavy clay loam or friable clay. At a depth ranging from 36 to 50 inches this gives way to red heavy clay loam or silty clay loam, which continues to a varying depth. A layer of stratified

material underlies this layer and consists in many places almost entirely of rounded quartz gravel and stone, the particles ranging from $\frac{1}{4}$ to 6 inches in diameter (pl. 2, *B*). Mixed with the gravel is some red or brown clay and sand. Here and there, small rounded pebbles are scattered throughout the soil mass, but most of this land is practically free from stone in the surface layer. Some of this soil has somewhat the characteristics of so-called push land, that is, it does not turn readily from the moldboard of the plow.

Hiwassee loam is considered one of the best, if not the best, agricultural soil in the county. Only a very small area is mapped. Plant roots readily penetrate both the surface soil and the subsoil. The soil readily absorbs large quantities of rain water and responds quickly to changes in moisture conditions. It is highly prized for the production of cotton and corn, and practically all of the land is under cultivation. Yields of cotton range from 300 to 450 pounds of lint to the acre, corn 20 to 35 bushels, and oats 10 to 40 bushels. Land for cotton receives 300 pounds of 4-12-4 or 4-8-4. Land for corn is fertilized with 100 to 150 pounds an acre of 4-8-4, and in some instances a light application of barnyard manure is given. Some farmers grow cotton on the same field for a number of years in succession, and others rotate cotton with corn. This soil responds readily to the use of barnyard manure, green-manure crops, and commercial fertilizer. It can be built up to a high state of productivity.

Wickham fine sandy loam.—The 8- to 12-inch surface soil of Wickham fine sandy loam is light-brown or grayish-brown mellow friable fine sandy loam. The subsoil, to a depth ranging from 30 to 36 inches, is yellowish-brown or reddish-brown moderately stiff but friable clay or silty clay, which generally contains a noticeable quantity of small mica scales. This material is underlain by red smooth micaceous clay loam or sandy loam, which is lighter textured and more friable than the typical subsoil. At a depth of 50 to 60 inches is the substratum consisting of soil material and rounded quartz pebbles.

Included with this soil as mapped are small areas from which a part or all of the original surface soil has been largely removed by erosion, exposing reddish-brown loam or clay loam. These areas are not considered so desirable for cultivated crops as the typical fine sandy loam. East of Mud Creek and one-fourth of a mile west of the Habersham County line in the northeastern part of the county, there are about 20 acres where the subsoil is yellow or brownish yellow.

Wickham fine sandy loam is inextensive. It is developed on the terraces and second bottoms that lie from 10 to 25 feet above the normal level of streams. It is not subject to overflow except during periods of extremely high water. Practically all of this soil occurs along the Chattahoochee, Chestatee, and Oconee Rivers and some of the larger tributaries. One of the larger areas is near the Iron Bridge across the Chattahoochee River west of Flowery Branch; an area is near Chestatee Church, and a small body is along the Oconee River about 4 miles from the eastern county line. All this soil has favorable relief, ranging from almost level to slightly undulating and gently sloping, with narrow steep escarpments leading down to the first-bottom soils.

Practically all of the land is under cultivation. It is considered a high-grade soil for the production of general farm crops. About 40 percent is used for the production of cotton, 40 percent for corn, 10 percent for small-grain and hay crops, and the rest for miscellaneous crops and pasture land. Cotton yields from one-half to four-fifths of a bale an acre where fertilized with 300 pounds of 6-8-4. Corn yields from 15 to 30 bushels when from 100 to 200 pounds of 6-8-4 fertilizer and a side dressing of 75 pounds of nitrate of soda are used. Fair yields of wheat and oats are obtained. Cowpeas and soybeans do well.

Wickham fine sandy loam, owing to its favorable relief and good physical characteristics, is capable of being built up to a high state of productivity. It is easy to till and responds readily to the application of fertilizers and barnyard manure or to the turning under of green-manure crops.

Altavista fine sandy loam.—The 5- to 8-inch surface layer of Altavista fine sandy loam is light-gray, grayish-yellow, or grayish-brown fine sandy loam. This is underlain, to a depth of 10 to 14 inches, by yellow or pale-yellow fine sandy loam. The subsoil is yellow heavy fine sandy clay or firm clay, which grades, at a depth of about 18 to 24 inches, into yellow, mottled with gray or light brown, fairly heavy stiff clay. Below a depth of 30 to 36 inches the material ranges in texture from heavy sandy clay to sandy loam and is somewhat variable in color but is dominantly mottled. In some places this material rests on coarse sandy loam or coarse sand and gravel. Included in mapping are areas of gray sandy loam and grayish-brown silt loam that are too small to be delineated on a map of the scale used. Here and there the surface soil contains a noticeable quantity of light-colored small rounded quartz pebbles.

Most of the soil occurs in very small areas associated with the other soils developed on the terraces and in the first bottoms, especially along the Oconee River in the eastern part of the county. It is developed on second bottoms or low terraces from rather old deposits of alluvium. The land is nearly level or gently undulating and slopes gradually toward the stream. Both surface and internal drainage range from fair to good.

Approximately 60 percent of the land is used for crops. The rest is in abandoned fields or grown up to second-growth pine. Corn, the principal crop, yields from 10 to 20 bushels an acre under ordinary conditions, but liberal applications of fertilizer or barnyard manure increase yields greatly. Some oats are grown, but yields are usually low.

Both the surface soil and the subsoil are strongly acid. Owing to the position of this soil on low flat second bottoms, some artificial drainage has been established through open ditches. The productive capacity can be considerably improved by turning under leguminous crops to increase the organic matter and by applying lime.

Congaree fine sandy loam.—To a depth of 12 to 15 inches, this soil is brown or grayish-brown mellow fine sandy loam. It is underlain to a depth of 30 to 36 inches by light-brown fine sandy loam or silt loam. This rests on stratified layers of brown and yellow loamy fine sand, fine sandy loam, and different-textured materials. In a few places the surface soil is reddish brown, owing to recent deposition of

material washed from adjacent areas of red soil. Numerous small mica flakes are scattered throughout the soil mass and in many places are abundant in the subsoil. Included with Congaree fine sandy loam are small areas of Congaree silt loam, sandy loam, and loamy fine sand.

This soil is developed from alluvial materials washed from the upland soils and deposited by streams during times of overflow. It occurs in small narrow areas along the various streams throughout the county. It lies slightly higher than the associated soils—Chewacla silt loam and alluvial soils (Congaree soil material). The land is almost level or slopes very gently toward the stream or in the direction of stream flow. Both surface and internal drainage are good for a soil developed in first bottoms. The land is subject to frequent overflow.

Practically all of this land is under cultivation, and the rest is in pasture. Corn, the principal crop, yields from 15 to 35 bushels an acre without the use of commercial fertilizer. Where the land is fertilized, yields are considerably increased. Some of this soil is used for the production of hay and returns from 1 to 1½ tons an acre. This soil is very easy to cultivate and maintains good moisture conditions. It is slightly acid in reaction. The supply of plant nutrients is better than in most of the upland soils. The soil is especially suited to the production of watermelons, as exceptionally large melons of fine flavor are obtained. Garden vegetables do well. The land affords excellent summer pasture for cattle.

Chewacla silt loam.—This soil is intermediate in characteristics between Congaree fine sandy loam and Wehadkee silt loam. The 8- to 15-inch surface soil is brown or grayish-brown mellow silt loam resembling the surface soil of Congaree fine sandy loam. The subsoil is light-gray, mottled with brown, heavy silt loam containing a noticeable quantity of small mica scales, which in some places give the material a soft greasy feel. In most places below a depth of 30 to 36 inches the subsoil grades into light-gray, stained with brown, laminated silt loam and silty clay.

Chewacla silt loam occurs in small areas in the first bottoms along the upper reaches of the Little River and Flat Creek in the northern part of the county. The soil is developed from recent alluvial materials washed from the adjacent uplands and deposited by streams during overflow. This soil lies only a few feet above the normal overflow of the streams, having a slightly lower position than the Congaree soil and a slightly higher one than the Wehadkee soil. It is fairly well drained for a first-bottom soil, but most of the areas used for agriculture have been drained artificially by means of shallow open ditches.

Approximately 50 percent of the land is cleared, drained, and used for the production of corn, sorgo, and hay crops. Ordinarily these crops do best during dry seasons. Corn yields from 15 to 25 bushels and hay from ½ to 1 ton an acre. Commercial fertilizer is not in common use. This soil produces good pasture grasses for cattle, and more of it could be used advantageously for this purpose. Most of the land has been cleared, but some of it supports a growth of alders and willows.

Wehadkee silt loam.—Wehadkee silt loam is a poorly drained soil occurring on the first bottoms of some of the larger creeks and

of the Oconee River. The soil has developed from low-lying alluvial materials washed from the adjacent upland soils and deposited by the streams at times of overflow. Overflow is frequent, natural drainage is poor, and part of the land is semiswampy.

The 6- or 8-inch surface soil is gray, or gray mottled with brown, silt loam. The subsoil consists of mottled gray, brown, and yellow friable silty clay and extends to a depth of about 3 feet. Below this in many places the material is more or less stratified and mixed in texture and color. Here and there it grades into fine sandy loam. In a few areas the surface soil is fine sandy loam, and in a few others it is silty clay loam.

Part of the land has been drained by shallow open ditches and reclaimed for agricultural purposes. Uncleared land supports a tree growth, mainly of alder, blackgum, birch, beech, and willow, and an undergrowth of reeds and coarse marsh grasses. A large part of this land is used for summer pasture for cattle. The areas under cultivation are devoted to the production of corn, yields of which range from 10 to 30 bushels an acre, depending on the season and drainage conditions. A small acreage is used for the growing of sorgo. If properly drained and limed, this soil would produce good yields of corn and hay. Good drainage, however, probably would require the deepening and widening of the creek channels throughout their extent.

Alluvial soils (Congaree soil material).—Alluvial soils (Congaree soil material) comprise a mixture of soil materials so varied in color, texture, structure, and sequence of the several soil layers, that no separation can be made into definite soil types. They are composed of recent alluvial materials together with a small amount of colluvial wash from the contiguous slopes. In most places the soil consists of red or brown alternating layers of material ranging from sand to silt. In places both the surface soil and the subsoil contain small flakes of mica.

This material occupies the first bottoms of nearly all of the large creeks, as well as those of the smaller drainageways, and, in places, of the rivers. It occurs in strips ranging in width from a few feet to one-fourth of a mile or more. It lies at or only a few feet above stream level. It is, therefore, subject to frequent overflow and the addition of new material with each overflow. The land is nearly level but slopes toward the stream or in the direction of stream flow. Originally, many of the creek bottoms were areas of uniformly developed first-bottom soils, dominantly Congaree silt loam, but they have become covered by deposition of mixed material. Clearing the adjacent hillsides and subsequent erosion has filled the stream channels and caused poor drainage.

Some of this land is under cultivation and is used for the production of corn, hay, and sorgo. Yields of corn depend on the character of the soil and the drainage conditions. Some of the land is used for summer pasture, and the rest is allowed to lie idle or is being reforested to alder, elm, ash, sycamore, birch, beech, sweetgum, and some pine. Deepening and straightening the natural stream channels and constructing ditches along the upland edges of the bottoms to intercept run-off from the upland slopes would aid in reclaiming this soil. If reclaimed, these soils, except where extremely sandy,

would have possibilities for growing corn and affording excellent pasture for cattle.

Rough broken land (Cecil-Madison soil materials).—Over one-fifth of the area of Hall County is classed as rough broken land (Cecil-Madison soil materials). The largest areas are in the northeastern and east-central parts, around and south of Airline School, and along the Chattahoochee River, particularly between the Bellton Bridge and the Hall-Habersham County line. Smaller areas here and there border the first bottoms and terraces of the rivers and larger creeks.

This land classification consists dominantly of Cecil and Madison soils, although spots of Davidson, Louisa, Madison, Appling, and Louisburg soils are present. These soils are so intricately associated and mixed that individual areas cannot be shown on a map of the scale used.

This rough broken land comprises knobs, narrow winding ridge tops, and slopes having a gradient ranging from 10 to 50 percent. The numerous knobs and narrow ridges cannot easily be terraced. In fact, in many places the subsoil is thin or almost lacking and the soft disintegrated rock is near the surface.

Probably less than 2 percent of this land is now in cultivated fields, and these are small spots of smooth-lying land or narrow strips of first-bottom soils. Probably 20 percent of this land has been cleared and once was cultivated. Increasingly serious erosion soon led to the abandonment of most fields. Broomsedge, briers, plum bushes, and small pine constitute the growth on the abandoned fields. Practically all of the merchantable timber has been cut, and by far the greater part of the land is now in shortleaf pine together with deciduous trees. The best use for this rough broken land is for forestry or for wildlife refuge.

PRODUCTIVITY RATINGS

Table 5 lists the soils of Hall County in the approximate order of their general productivity for the common crops under recommended soil-management practices. The most productive soils are at the head of the table and the least productive at the foot. The order is modified to some extent to show the comparative desirability of the soils as influenced by their workability and erodibility.

The rating compares the productivity of each soil for each crop to a standard, namely 100. This standard index represents the approximate average acre yield obtained without the use of amendments on the more extensive and better soil types of the regions in which the crop is commonly grown. An index of 50 indicates that the soil is about one-half as productive for the specified crop as are those with the standard index. Soils given amendments, such as lime and commercial fertilizers, and unusually productive soils of small extent may have productivity indexes of more than 100 for some crops.

The following tabulation sets forth some of the acre yields that have been set up as standards of 100. They represent long-time average yields of crops of satisfactory quality on the better soils of the United States without the use of amendments.

Crop:		
Cottonpounds	400
Cornbushels	50
Oatsdo.	50

The rating in the column headed A under each crop indicates yields obtained under average or common soil-management practices, which, on most of the soils, include the use of moderate quantities of commercial fertilizers. On a few of the more fertile soils, including Congaree fine sandy loam, Chewacla silt loam, and Altavista fine sandy loam, little or no fertilizer is used in common practice. In the column headed B, yields under recommended practices are given. These practices consist of regular crop rotation including the growing of legumes, the use of barnyard and green manures, application of liberal quantities of complete commercial fertilizers, the use of improved varieties and high quality of seed, and, in some areas, the use of mechanical measures, such as contour tillage, strip cropping, and terracing, for the control of erosion. Some of the soils of the low terraces and bottom lands, including Chewacla silt loam, Altavista fine sandy loam, and Wehadkee silt loam, are imperfectly or poorly drained. The indexes given in column B for these soils are for production with artificial drainage and fertilization.

The principal factors affecting the productivity of the land are climate, soil (this includes the many physical, chemical, and biological characteristics), slope, drainage, and management, including the use of amendments. No one of these factors operates separately from the others, although some one may dominate. Crop yields over a long period of years furnish the best available summation of the associated factors, and, therefore, are used where available. In Hall County many of the indexes are based on estimated yields rather than on reported yields, as definite information is scarce. Interviews with farmers combined with the observations of members of the soil survey party were depended on for information on which to base estimates of yields.

Because of limited information, the indexes for vegetables are not based on a standard but are only comparative for this county. An index of 100 is given the soil that appears to be most productive under recommended management, and the other soils are given comparative ratings. Little information on the quality and carrying capacity of pastures is available, and, therefore, only general statements are used to indicate the productivity of the soils for pasture. Many of the better soils are cultivated almost entirely and are used little, if at all, for pasture. Such soils are given no rating for pasture, although it seems reasonable to assume that they would support good pasture.

The soils are listed in the order of their general productivity under recommended practices, and productivity grade numbers are assigned in the column, "General productivity grade." The general productivity grade is based on a weighted average of the indexes for the various crops, the weighting depending on their relative acreage and value. If the weighted average is between 90 and 100, the soil type is given a grade of 1; if it is between 80 and 90, a grade of 2 is given, and so on. Since it is difficult to measure or express mathematically either the exact significance of a crop in local agriculture or the importance and suitability of given soils for particular crops, the weightings are used only as guides.

TABLE 5.—Productivity ratings of the soils of Hall County, Ga.

Soil (soil types, phases, complexes, and land types) ¹	Crop productivity index ² for—										General productivity, grade ³		Remarks concerning fertility, workability, and erodibility	Land classification ⁴
	Cotton		Corn		Oats		Vegetables ³		Pasture ⁴	A	B			
	A	B	A	B	A	B	A	B						
Hilwassee loam.....	70	100	50	80	40	80	60	100	-----	4	1	} First-Class soils (good cropland, also capable of supporting fair to good pasture).		
Congaree fine sandy loam ⁷	-----	90	50	90	40	80	70	100	Good.....	5	1			
Wickham fine sandy loam..	60	95	40	75	35	70	50	95	...do.....	5	2			
Davidson clay loam.....	45	90	40	80	40	80	40	80	...do.....	6	2			
Madison sandy loam.....	50	100	30	70	30	75	50	100	-----	6	2			
Cecil sandy loam.....	40	100	30	60	30	60	45	90	-----	7	2			
Madison sandy loam, eroded phase.	40	90	30	65	30	70	45	95	-----	7	3			
Madison clay loam.....	40	90	30	65	30	70	45	90	Good.....	7	3			
Cecil clay loam.....	40	90	30	65	30	65	40	80	-----	7	3			
Cecil sandy loam, eroded phase.	40	90	30	60	30	60	40	80	-----	7	3			
Chewacla silt loam ⁸	-----	-----	40	70	25	55	-----	-----	Good.....	7	4	} Second-Class soils (fair cropland, also capable of supporting fair to good pasture).		
Altavista fine sandy loam ²	40	70	35	60	25	50	-----	-----	...do.....	6	4			
Appling sandy loam.....	30	70	20	60	25	50	35	60	Fair to good...	8	4			
Mecklenburg gravelly loam, shallow phase.	35	60	25	55	30	60	-----	-----	-----	7	5			
Madison clay loam, hilly phase. ⁹	30	80	30	70	30	70	30	70	Fair to good...	7	4			
Cecil clay loam, hilly phase ⁹	30	80	20	60	20	60	30	70	...do.....	8	4			

Appling sandy loam, hilly phase. ⁹	50		40	40	50	Fair	8	6	Hilly and steep; highly erodible; low fertility	} Third-Class soils (poor cropland or fair to good pasture land. Many areas in forest).	
Louisburg sandy loam	50		35	35	40		8	6	Hilly and steep; soil shallow and droughty; erodes readily if not protected.		
Louisa-Madison gravelly fine sandy loams.	25	40	20	30	20	30	Fair	8	7		Rather low fertility; soil shallow and droughty; erodes readily if not protected.
Alluvial soils (Congaree soil material).				40		40	Good	8	6		Fertile, poorly drained; frequently flooded.
Wehadkee silt loam ¹⁰				60		40	do	8	6		Poorly drained; frequently flooded
Louisa-Madison gravelly fine sandy loams, hilly phases. ⁹	50						Fair to good	8	6	Hilly and steep; shallow soil; highly erodible.	
Worsham sandy loam							Good	8		Poorly drained; occurs in small patches	} Fourth-Class soils (fair to good pasture land).
Davidson clay loam, hilly phase. ¹¹							Fair to good	9		Hilly and steep; highly erodible; rather low fertility.	
Rough broken land (Cecil-Madison soil materials).							Poor	10		Steep and rough; shallow soil; highly erodible.	Fifth-Class soils (forest land).

¹ The soils are listed in the approximate order of their general productivity under recommended soil-management practices.

² The soils of Hall County are given indexes that indicate the estimated average production of each crop in percent of the standard of reference. The standard represents the approximate average yield obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. The indexes in the column headed A under each crop refer to yields obtained under the common soil management practices that include the use of moderate quantities of fertilizers on most of the soils, the indexes in column B refer to yields that may be expected under careful management, including crop rotation, fertilization, and liming, as recommended in the section on Land Uses and Soil Management.

³ The indexes for vegetables are comparative for the soils of this county and, because of insufficient data, are not based on standards of reference.

⁴ Because of insufficient data, it was impossible to characterize the carrying capacity of the pastures on the different soils in any but general comparative terms.

⁵ This classification indicates the comparative general productivity of the soils for the common crops under: (A) Common soil-management practices, and (B) under the better management practices recommended in the section on Land Uses and Soil Management. Actually, of course, more variations in management practices exist than have been indicated in columns A and B.

⁶ This grouping indicates in a general way the use capabilities of the various soil types, phases, complexes, and land types.

⁷ The ratings for Congaree fine sandy loam in the columns headed A are for production of crops without use of fertilizers as they are seldom used on this soil. Only a small acreage of this soil that is least subject to flooding is devoted to cotton.

⁸ The ratings for Chewacla silt loam and Altavista fine sandy loam in the columns headed A are for production without artificial drainage and fertilization, whereas those in columns B are for production with artificial drainage and fertilization.

⁹ The ratings for these hilly phases are only for the smoother and less eroded areas. The conditions of slope, soil depth, and productivity vary greatly, and it is impossible to give a set of indexes that are representative of the total area of each phase. The steeper parts are almost entirely unsuited to cultivation.

¹⁰ Wehadkee silt loam is poorly drained. Only a very small artificially drained area is suitable for growing corn.

¹¹ Davidson clay loam, hilly phase, is mostly very hilly and steep. Only a few very small areas are smooth enough to be farmed, and these are about as productive as like areas of Cecil clay loam, hilly phase.

NOTE — Absence of an index indicates that the crop is not commonly grown, because of poor adaptation.

Under the column headed "Remarks concerning fertility, workability, and erodibility" are listed many of the factors determining the suitability of the soil for growing crops, grasses, or trees. These include lay of the land, depth of soil, fertility, responsiveness to fertilization, drainage, susceptibility to overflow, and erodibility.

In the column headed "Land classification," the soils are grouped according to their comparative desirability or physical suitability for crop growing, grazing, or forestry.

The best soils of the county, grouped as First-Class soils, are considered to be good cropland. That is, they are, in general, capable of moderate to rather high production of the common crops under good soil-management practices; they are rather easily worked; and it is not difficult to maintain productivity. In short, it is possible to farm these soils rather intensively and at the same time conserve them without great difficulty. The land is so desirable for crops that comparatively little of it is devoted to pasture or wood lots, in spite of the fact that it will support a good growth of pasture grasses or trees. Some small areas of inferior soils, owing principally to steep slope and erosion, are included in the soils grouped in this class.

Second-Class soils are considered somewhat less desirable and are designated as fair cropland. They are generally somewhat less productive than the First-Class soils, and as a rule are somewhat harder to till or more difficult to conserve if tilled. They are capable of supporting fair to good pasture, and some areas are in timber.

Third-Class soils are considered as poor cropland or fair to good pasture land. They are of medium to low productivity and are generally rather hard to till or to protect from erosion.

Fourth-Class soils are almost entirely unsuited for crop growing. They are considered fair to good pasture land and support forest in places. Poor drainage or rough, steep lay of the land make tillage almost impossible.

Fifth-Class soils include only rough broken land (Cecil-Madison soil materials). The land is not well suited to any purpose but forestry.

The productivity rating and land classification do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. They give a characterization to the productivity and use capabilities of the individual soil types, but they do not picture the total production of crops by soil types, as this depends so much on the acreage of each type devoted to each crop.

Economic considerations have played no part in determining the crop indexes and little part in determining the land classification; therefore, neither indexes nor soil classes can be interpreted into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. The association or the pattern of distribution of soil types in any particular locality or farm may have a very important influence on the use and value of the land. Such conditions are not adequately covered in this classification.

LAND USES AND SOIL MANAGEMENT

The capabilities of many of the soils in Hall County never have been fully realized or appreciated by some of the landowners. Be-

cause of their inherent qualities, many soils can be greatly improved, and their productivity can be easily maintained through proper management, including in the rotation a leguminous crop. Thousands of acres having steep relief or a shallow soil covering over bedrock, however, never should have been cleared of tree growth and allowed to wash, gully, and become practically ruined for any profitable farming purpose.

In any well-planned farm program, proper use of the soil is fundamental. Some farmers in Hall County do make excellent use of their soils as regards the crop adaptation and the market demand for crops. Today, however, they practice more diversification than they have in the past. They are being careful to plow and cultivate along the contours, seed the land to grasses, and rotate crops so that some cover protects the surface soil throughout most of the year. Many farmers grow lespedeza and kudzu. Both soil and climatic conditions favor the growth of a wide variety of crops.

The surface soils in this county are naturally low in organic matter and soluble plant nutrients. The reaction is acid in both the surface soil and the subsoil. The soils have undergone considerable leaching of both the organic matter and the soluble plant nutrients. Pronounced sheet and gully erosion further impoverish the soil, particularly on those sloping or hilly areas long devoted to clean-cultivated crops. This has resulted in abandonment of many fields, which have grown up to broomsedge, later to briars, and eventually to shortleaf or loblolly pine. Some of the most severely eroded areas have reforested to pines. It was the custom, in the early development of the county, when land was plentiful, to clear the land, plant it in cotton for several years until the surface soil had become eroded, and then abandon it. Many areas have been cleared of trees a second time and in some instances a third time, and returned to cultivated crops (pl. 3, A). Economic conditions are largely responsible for such changes in land use. During periods of high prices for cotton, land was rapidly cleared and placed under cultivation, whereas during periods of low prices much land was abandoned.

About 1920 the boll weevil invaded this territory, and its ravages on cotton were added to a period of declining cotton prices. In 1935 only about one-third of the land of the county was used for the production of crops; the rest consisted of woodland, abandoned areas, and fallow fields. Approximately one-half of the harvested cropland was in corn, one-third in cotton, and the remainder in miscellaneous crops, such as wheat, oats, rye, cowpeas, soybeans, lespedeza, and crimson clover.

On the accompanying soil map there are 25 soil types, phases, and miscellaneous soils and land classifications. For purposes of discussion, these have been placed in six groups as follows: (1) Gray sandy soils of the uplands, (2) red clay loam soils of the uplands, (3) miscellaneous soils of the uplands, (4) red to gray soils of the terraces, (5) brown to gray soils of the first bottoms, and (6) rough broken land.

Under the group of gray sandy soils of the uplands are Cecil sandy loam, Appling sandy loam, Madison sandy loam, Louisa-Madison gravelly fine sandy loams, eroded phases of Cecil and Madison sandy loams, and hilly phases of Appling sandy loam and Louisa-Madison

gravelly fine sandy loams. All these soils have very friable surface soils, are naturally well drained, and warm early in the spring. Injury from the boll weevil is less on them than on other soils in the county. This is due to the fact that cotton matures earlier on the sandy soils than on the heavier soils. When properly fertilized the sandy soils are considered, under conditions of boll weevil infestation, the best soils for the production of cotton. They are very easy to till, and light farming implements are adequate.

Soils of the eroded and hilly phases of these soils are handled in about the same way as the sandy loams. The soils of the phases, however, because of their variations in texture, particularly in the eroded areas, and because of the steep slope in the hilly areas, are not handled so easily as the soils in smoother areas. They require terracing and strip farming to check erosion. Cultivation is not quite so easy and moisture conditions not so favorable as on the typical sandy loams. Pasture grasses do not do so well on these soils as on the heavier clay lands.

The red clay loam soils of the uplands, the so-called red lands, comprise Cecil clay loam, Davidson clay loam, Madison clay loam, and the hilly phases of these soils. They are naturally strong soils. They contain more plant nutrients and are better suited to grain and hay crops than the light-textured sandy soils. On the other hand, they are more difficult to cultivate, can be cultivated within a narrower range of moisture conditions, and require heavier equipment and stronger work animals than the sandy soils. Corn, wheat, red clover, soybeans, and alfalfa can be grown successfully. The Davidson soils particularly return good yields of alfalfa and maintain good pasture grasses. These features make them ideal for dairy farming. The hilly phases of these soils in many places do not have so thick a surface soil and subsoil over the parent material as the typical clay loams. In many places they have become severely eroded and gullied, and many areas have been abandoned for farming and allowed to revert to forest. Under proper management, however, thousands of such acres can be reclaimed for pasture, whereas the more gullied and steeper areas should remain in forest.

Miscellaneous soils of the uplands include Mecklenburg gravelly loam, shallow phase, Louisburg sandy loam, and Worsham sandy loam. These soils are very different in their characteristics, soil development, and crop uses. Some areas of Mecklenburg gravelly loam, shallow phase, produce fair crops of cotton, whereas Louisburg sandy loam has a low agricultural value even for ordinary farm crops. In North Carolina it is used for the production of bright-leaf tobacco. Worsham sandy loam is poorly drained, but it is a valuable soil within a farm, as it fits in for pasture and affords good grazing, especially where it has been seeded to a mixture of carpet grass, Dallis grass, and lespedeza.

Inherently, the soils of the terraces and first bottoms are among the best soils in the county. Hiwassee loam, Wickham fine sandy loam, and Altavista fine sandy loam produce good yields of corn, grain, and cotton. Their relief is favorable for cultivation and does not subject them to serious erosion. Congaree fine sandy loam and the better drained areas of Chewacla silt loam are well adapted to the production of corn and pasture grasses, whereas Wehadkee silt loam,

in its naturally poorly drained condition, is too wet to be farmed. It can be reclaimed easily for pasture.

Rough broken land (Cecil-Madison soil materials) covers a large area. With the exception of very small bodies here and there, this land is best suited for forestry and wildlife.

Based on the results of experiments, the Georgia State College of Agriculture recommends Austrian Winter peas, hairy vetch, and crimson clover as winter cover crops in rotation with cotton and corn. Where organic matter is so deficient that stands of winter legumes cannot be obtained, the college recommends that rye or sorgo be grown and turned under until the land will support legumes. It also recommends that some of the legumes be grown for soil improvement and as feed for livestock, and that cowpeas or soybeans be interplanted with corn and sown after the wheat and oats.

The need for organic matter in the soils can be met by applying manure or by growing legumes to be plowed under in the regular crop rotation. Since very little livestock is kept, the main source for organic material necessarily will be from legumes. It is reported that the acreage of hairy vetch and Austrian Winter peas has increased considerably in the last few years. An application of 1 ton per acre of ground limestone is advisable on most of the soils for the successful growing of crimson clover and other leguminous crops. Particularly is this true if the soil shows a pH value below 5.5.

The following rotation used by the Soil Conservation Service of the United States Department of Agriculture, in the Little River Project, can be readily adapted to conditions on many farms in Hall County:⁸ First year, cotton followed by one of the following winter legumes sown in fall—(1) crimson clover, (2) Austrian Winter peas, or (3) vetch; second year, winter legume plowed under in April, followed by corn interplanted with cowpeas or soybeans, and this followed by small grain sown in fall; third year, lespedeza sown early in spring, followed by small grain harvested as hay or threshed, or small grain harvested as hay or threshed and followed by cowpeas; and fourth year, legumes plowed under in March and followed by cotton.

This rotation has a number of obvious advantages, especially where combined with proper fertilization of the various crops. The winter legumes are able to utilize the residual effects of the fertilizer used on the immediately preceding crops. They also pick up and hold additional plant nutrients, particularly nitrogen, which becomes available in the soil during the winter and otherwise would largely be lost through leaching. The crops that are plowed under immediately preceding the corn and cotton add to the available supply of nitrogen in the soil. They also temporarily increase the content of organic matter, increase the water-holding capacity, and make conditions more favorable for tillage operations.

Where this rotation is used, the Division of Agronomy of the Georgia State College of Agriculture recommends for Cecil sandy loam, Appling sandy loam, Madison sandy loam, and Louisa-Madison gravelly fine sandy loams, as well as for the eroded and hilly phases of these soils, the following fertilizer treatments: For cotton, 400 pounds of 4-8-4, with a top dressing of 100 pounds of nitrate of

⁸ Information furnished by G. C. Rice, agronomist, Soil Conservation Service.

soda and 32 pounds of muriate of potash to the acre at chopping time; for corn, no fertilization if a heavy green-manure crop has been turned under, otherwise from 100 to 200 pounds of nitrate of soda; for small grain, 200 to 300 pounds of 16-percent superphosphate in fall followed by a top dressing of 100 to 150 pounds of nitrate of soda early in spring.

Where a heavy leguminous crop has been turned under on areas of Cecil clay loam, Madison clay loam, Davidson clay loam, Hiwassee loam, or Mecklenburg gravelly loam, shallow phase, an 0-8-4 fertilizer could be used instead of 4-8-4. The heavier applications of nitrogen are especially important on Appling sandy loam and Altavista fine sandy loam. Barnyard manure, if available, should be applied early in spring before the land is broken for corn.

Ordinarily it is not considered necessary to apply fertilizer for crimson clover, Austrian Winter peas, or vetch at time of planting if they are grown in a rotation with other crops that have received liberal applications of phosphates. If, however, they are grown on land that has not recently been fertilized with phosphates, they should be given from 200 to 400 pounds of superphosphate or its equivalent of basic slag. In addition, on Cecil sandy loam, Appling sandy loam, and Altavista fine sandy loam, an application of barnyard manure should be applied before the land is prepared. If this is not available, a 4-12-4 fertilizer should be used.

Cotton grown without legumes in the rotation should be fertilized with 400 pounds of 4-8-4, followed by a top dressing of 150 to 200 pounds of nitrate of soda, or an equivalent amount of sulfate of ammonia. The top dressing should also include 32 pounds of muriate of potash. The application of potash is especially important on Davidson clay loam and Mecklenburg gravelly loam, shallow phase.

Truck crops should be fertilized with 1,000 to 2,000 pounds to the acre of 5-7-5. This should be supplemented by an application of barnyard manure. Where a heavy application of fertilizer is used, it should be applied in the row at least 10 days before the seed is planted, or a distributor should be used that will place the fertilizer approximately 3 inches from the seed so as to prevent injury to the germinating plant. Nitrates not taken up by plants are rapidly leached from the soil. For this reason two light top dressings are frequently more beneficial than a single heavy application.

Control of erosion is one of the most serious problems that confronts the farmers of this county. In a study of the loss of soil moisture and plant nutrients on Cecil sandy clay loam with a 5-percent slope, conducted on the farm of the College of Agriculture of the University of Georgia at Athens, the following losses of soil through surface runoff under different land use practices were recorded during the period July 1, 1933, to June 24, 1934:⁹

	<i>Pounds per acre</i>
Plot A—Wooded area—part of the original hardwood forest cover had been removed, but trees and undergrowth still completely covered the ground.....	115
Plot B—Exposed subsoil area or badly eroded land (desurfaced).....	112, 316
Plot C—Continuous crop cover area—cowpeas broadcast in early July, plowed under after frost, Austrian Winter peas planted broadcast, cowpeas again planted in May.....	1, 510

⁹ COLLINS, W. O. SOIL EROSION EXPERIMENTS. Ga. Univ. Bul. v. 35, No. 10B, 8 pp., illus. 1935.



A, Land once farmed, abandoned, and reforested, again being cleared for crops. Note arrested gully erosion at edge of pine forest. *B*, Successful terracing on a 10- to 12-percent slope of Cecil sandy loam.

	<i>Pounds per acre</i>
Plot D—Tilled areas—cultivated to a depth of 3 inches every time it was dry enough between rains-----	14, 306
Plot E—Deep-tilled areas—cultivated to a depth of 6 inches every time it was dry enough between rains -----	15, 037
Plot G—Fallow land—soil tilled to a depth of 8 inches and left smooth-surfaced. No further treatment was given this plot, the surface soil not being protected either by cultivating or by cover crops--	159, 783

The surface slope of the experimental plot described above is the same or even less than that of most of the cultivable soils in Hall County. These results emphasize the desirability of maintaining a high level of soil fertility and ample vegetative cover in order to control soil erosion.

Careful terracing (pl. 3, *B*) is also essential as an aid in controlling erosion on all except the alluvial soils. Terracing of the soils has been practiced in Hall County for a long time. Some of the terraces were neglected, the water furrow became filled with soil, and the terrace broke, causing much damage to soil and terraces lower in the field. New and broader terraces are now being built by many farmers. These new terraces are laid out precisely as to gradient, and the water from them empties on to a meadow strip or runway.

Strip cropping and seeding the slopes to lespedeza or Bermuda grass are also recommended highly, for the purpose of checking erosion. More of the hilly phases of the Cecil, Madison, Davidson, and Appling soils, especially abandoned fields, could be planted to Bermuda grass or lespedeza. Similar areas planted to kudzu would greatly increase the supplies of forage and pasture crops and aid in controlling erosion and gulying. Preservation and care of timber on the hilly areas and rough broken land, over a period of years, would make environmental conditions favorable for an increase in wildlife, as well as add to the value of the timber.

The carrying capacity of pastures on Chewacla silt loam, Wehadkee silt loam, and the small areas of alluvial soils (Congaree soil material) that are poorly drained could be increased by artificially draining these soils with shallow open ditches.

In some parts of the county, large acreages are planted to varieties of cotton producing very short staple. Variety tests of cotton made at the Georgia State College of Agriculture, Athens, and at Clemson College, S. C., indicate that higher money value to the acre and greater profits are obtained by planting some of the well-adapted varieties having longer staple. This is especially true when such varieties are grown exclusively by communities so that uniform lots of unmixed high-quality staple are offered to buyers.

Large quantities of peaches and apples are produced in Habersham County, which adjoins Hall County on the northeast. It seems probable, therefore, that the long smooth slopes of the Cecil or Madison soils in the northern part of Hall County would have climatic and soil conditions suited to commercial orchards. Likewise, cabbage, potatoes, and other truck crops could be grown successfully in this section if marketing conditions were favorable.

There are good possibilities for the further development of the dairy industry in connection with the use of legumes and other hay crops in the rotation. This would necessitate an extension of the use of permanent or rotated pastures.

The following publications are suggested by the College of Agriculture of the University of Georgia, Athens Ga., for more detailed information on crops and soil improvement that may apply to the agriculture of Hall County:

University of Georgia Bulletin v. 35, No. 10B, Soil Erosion Experiments.

Georgia State College of Agriculture Extension Bulletins 356, Kudzu; 394, Terracing Farm Land in Georgia; 446, Forest Management in Georgia; 449, One-Variety Community Cotton Production; 452, Crimson Clover for Fertilizer, Feed and Soil Protection; 453, Austrian Winter Peas and the Vetches for Fertilizer, Feed and Soil Protection; and 456, A Survey of the Varieties of Cotton Grown in Georgia in 1935.

Georgia State College of Agriculture Extension Circulars 124, Corn Fertilizer for Georgia; 125, Small Grain Fertilizer for Georgia; 135, New Fertilizer Materials; and 260, Terrace Maintenance.

The following publications are suggested by the Georgia Experiment Station, Experiment, Ga.:

Georgia Experiment Station Bulletins 151, Fertilizer Ratio Experiments Conducted on Cecil Sandy Clay Loam; Cotton, Corn and Wheat Grown in Rotation; and 152, Cotton Fertilizers and Cultural Methods.

Georgia Experiment Station Forty-sixth Annual Report, for the year 1933-34; Forty-seventh Annual Report, for the year 1934-35; Forty-eighth Annual Report, for the year 1935-36.

MORPHOLOGY AND GENESIS OF SOILS

Hall County is in the northern part of the Piedmont Plateau of Georgia. It is in the region of Red and Yellow Podzolic soils. The northern part of the county is only a short distance from the eastern escarpment of the Blue Ridge, which marks the southern extremity of the Gray-Brown Podzolic soils region.

The elevation for the greater part of the county ranges from about 1,000 to 1,200 feet above sea level. The lowest elevation is between 600 and 700 feet, and a few isolated peaks have an elevation of as much as 2,000 feet. Stream dissection has been severe and deep in many places. Surface drainage of all the upland soils ranges from excellent to excessive.

Originally the soils supported a growth of hardwoods including mainly several varieties of oak, together with some hickory, poplar, dogwood, sourwood, and shortleaf pine. Areas that have reforested naturally, such as abandoned fields and in some places cut-over lands, now support mainly loblolly pines, with mixed hardwoods in some places. The natural growth of grass is sparse, compared with that on areas farther north in the United States. The original forest cover has not been conducive to the accumulation of a great quantity of organic matter in the surface soil, as in the Prairie or some other soil regions.

This county lies in a section where the annual precipitation is high, with a mean annual rainfall of 53 inches, fairly well distributed throughout the year. Such a heavy rainfall has favored the leaching of whatever organic material that otherwise would accumulate, and the warm temperature prevailing throughout the long summers has further assisted in complete oxidation of the organic material. The result of these conditions is that very little organic matter remains in any of the soils. In few places, even in virgin areas, is it present below a depth of 2 inches. The organic matter is but partly disintegrated and in many places consists merely of litter on the surface.

Consequently, the soils have formed without any coloration from the organic decomposition below the topmost inch or two, and they have a light color (gray, light brown, grayish yellow, and red) in the A horizon.

A further result of the heavy precipitation and warm temperature has been to leach almost completely all calcium carbonate and other soluble bases from the soil. The soils range from slightly acid to strongly acid. Table 6 gives the pH values for several of the important soils in this county.

TABLE 6.—pH determinations on several soil profiles from Hall County, Ga.¹

Soil type and sample No.	Depth	pH	Soil type and sample No.	Depth	pH
Cecil sandy loam:	<i>Inches</i>		Davidson clay loam:	<i>Inches</i>	
259553.....	½ - 2	4.8	259520.....	1½ - 4	5.7
259554.....	2 - 6	4.9	259521.....	4 - 15	5.2
259555.....	6 - 10	4.7	259522.....	15 - 20	4.6
259556.....	10 - 18	4.6	259523.....	20 - 30	4.4
259557.....	18 - 24	4.6	259524.....	30 - 60	4.2
259558.....	24 - 32	4.4	Hiwassee loam:		
259559.....	32 - 40	4.7	259526.....	0 - 6	4.9
259560.....	40 -100+	4.6	259527.....	6 - 14	4.9
Madison sandy loam:			259528.....	14 - 36	5.3
259538.....	1 - 7	4.9	259529.....	36 - 60	4.4
259539.....	7 - 11	4.9	259530.....	60 -180	4.3
259540.....	11 - 14	4.5	Wickham fine sandy loam:		
259541.....	14 - 21	4.5	259572.....	0 - 10	5.3
259542.....	21 - 36	4.6	259573.....	10 - 20	5.6
259543.....	36 - 72	4.6	259574.....	20 - 36	5.3
Appling sandy loam:			259575.....	36+	5.3
259503.....	1 - 9	5.2			
259504.....	9 - 12	5.2			
259505.....	12 - 15	4.4			
259506.....	15 - 18	4.6			
259507.....	18 - 32	4.3			
259508.....	32 - 35	4.2			
259509.....	35 - 84+	4.1			
259510.....	108+	4.4			

¹ Determinations made by the hydrogen-electrode method in the laboratories of the Bureau of Plant Industry.

The parent materials from which the soils are derived consist of granite, gneiss, schist, quartz-mica schist, and ferromagnesian rocks, principally hornblende schist. These rocks, with the exception of some of the hornblende schist, have weathered to depths ranging from 10 to 80 feet. The soils have developed through the soil-forming processes from these disintegrated rock materials. The gneisses predominate throughout the county, although there are large areas of quartz-mica schist and some of granite. Direct relationships exist in many places between the parent materials and the resultant soils, as shown in table 7.

TABLE 7.—Relationship of parent material and soil series

Parent material	Soil series	Brief description of series
Granites, gneisses, and schist.	Cecil.....	Normally developed profiles, grayish-yellow sandy loam A horizon and red stiff brittle clay in B horizon. Sheet erosion of the sandy surface covering has produced a clay loam A horizon.
	Appling.....	Grayish-yellow or light-gray sandy A horizons and yellowish-red or yellowish-brown mottled stiff but brittle clay B horizons.
	Louisburg.....	A-C soil. Light-gray sandy A horizon; very thin or no definite B horizon. Disintegrated granite and gneiss.
	Worsham.....	Gray sandy loam A horizon, mottled yellow and gray or almost white; stiff clay B horizon. Poorly drained.

TABLE 7.—*Relationship of parent material and soil series*—Continued

Parent material	Soil series	Brief description of series
Quartz-mica schist.....	Madison.....	Gray-brown or light-brown sandy loam A horizon; red fairly stiff clay B ₁ horizon; and light-red friable micaceous B ₂ horizon. Sheet-eroded areas give a reddish-brown clay loam A horizon.
Quartz-mica schist and mica schist.	} Louisa-Madison...	Small areas of Madison soils intricately associated with small areas of A-C soils, which are the true Louisa soils.
Ferromagnesian rocks, principally hornblende schist.		Davidson.....
	Mecklenburg.....	Brown or grayish-brown A horizon and thin layer of yellowish-brown moderately stiff but plastic clay.
	Hiwassee.....	Reddish-brown or brown loam A horizon and red friable to heavy clay B horizon.
Old alluvium (terraces and second bottoms).	Wickham.....	Grayish-brown or light-brown fine sandy loam A horizon and yellowish-brown or reddish-brown moderately heavy clay B horizon.
	Altavista.....	Gray or light-brown fine sandy loam A horizon and yellow moderately heavy clay B horizon.
	Congaree.....	Brown fine sandy loam without profile development; contains small mica scales.
Recent alluvium (first bottoms).	Chewacla.....	Brown silt loam A horizon and mottled gray and yellow silty clay B horizon.
	Wehadkee.....	Gray silt loam A horizon and mottled light-gray and yellow silty clay B horizon.

This table does not include alluvial soils (Congaree soil material), or rough broken land (Cecil-Madison soil materials). The alluvial soils comprise mixed textures of fine sand, fine sandy loam, and silt loam, which could not be mapped separately on a map of the scale used. Rough broken land (Cecil-Madison soil materials) represents not only the roughest relief in the county but some of the most variable profiles and many A-C soils.

The soils of Hall County may be classified broadly into two groups, according to maturity of the soil profile. The first group includes all those soils in which a normal mature profile has developed. The second group includes all those soils in which a normal profile has not been developed, owing to poor drainage, or, once developed, has been destroyed by erosion.

The first group includes Cecil sandy loam, Appling sandy loam, Madison sandy loam, Hiwassee loam, and Wickham fine sandy loam. In all these soils sesquioxides from the A horizon have accumulated in the B horizon, where advanced oxidation has progressed to considerable depths. The removal of the iron from the surface soils, together with the practical absence of organic matter, has given rise to very light colored soils. The surface layer is, in most places, highly eluviated, whereas the B horizon is illuviated.

The second group includes all the other soil types and phases in the county. At one time Cecil sandy loam, eroded phase, and Madison sandy loam, eroded phase, had normally developed profiles, but sheet erosion has partly destroyed them. The hilly phases of Cecil clay loam, Appling sandy loam, Davidson clay loam, Madison clay loam, and the Louisa-Madison soils, in most places, do not have well-developed profiles, as the relief is steep and geologic erosion keeps close pace with rock weathering and soil formation.

The soils of Hall County have a lighter texture, shallower solum, and more friable consistence than the same soil types in the central or lower parts of the Piedmont Plateau of Georgia. These variations may be due to the comparatively cooler climate, which has

influenced, to some extent, the soil-forming processes in Hall County. The transitional character of the soils in Hall County toward the Gray-Brown Podzolic soils is evident in Cecil sandy loam, particularly northward from Lula to Skitt Mountain. The Cecil soil has a brownish cast in the B horizon.

It seems clear that the Cecil soils in this section show evidence of both podzolic and lateritic processes. The relative influence of each of these processes within a region has not been determined. After a study of colloidal material of the various horizons of a Cecil sandy clay loam profile, Byers, Alexander, and Holmes¹⁰ write: "The silica-sesquioxide and silica-alumina ratios show that the soil-forming process has brought about a decrease in these ratios. Thus the colloid of the sandy A horizon is more lateritic, even, than the lateritic material from which it is formed." After considering evidence presented by Marbut¹¹ and others, Joffe¹² states: "The Cecil soils seem to be definitely lateritic." The podzolic character of the Cecil soils has also been recognized.¹³

Cecil sandy loam may be taken as an example of a soil that has developed a normal mature profile in Hall County. A description of a profile of Cecil sandy loam included in an area on the map with Cecil sandy loam, eroded phase, 1 mile south of Pool School in the eastern part of the county, is as follows:

- A₀₀. 0 to ½ inch, oak leaves.
- A₁. ½ to 2 inches, dark-gray sandy loam with no definite structure, held together by a mass of fine interwoven roots.
- A₂. 2 to 6 inches, grayish-yellow sandy loam with penetrations of dark-gray material from above.
- A₃. 6 to 10 inches, yellowish-red heavy sandy loam with slight penetrations of grayish-yellow material from above. The material in this horizon breaks into slightly consolidated fine clods. A sharp line of demarcation separates this and the next lower horizon.
- B₁. 10 to 18 inches, red heavy massive clay loam. This material contains small scales of mica and quartz sand.
- B₂. 18 to 24 inches, red moderately stiff massive clay. Micaceous material is more abundant than in the horizon above. Faint yellowish-brown streaks follow root channels and other openings.
- B₃. 24 to 32 inches, red friable massive clay containing a considerable quantity of mica.
- C₁. 32 to 40 inches, red, finely mottled and streaked with pink and yellowish-brown, micaceous clay. The pattern of mottling resembles that of the parent rock. A few tree roots penetrate this horizon.
- C₂. 40 to 100 inches +, red, mottled with pink, yellowish brown, and grayish yellow, friable micaceous clayey material containing here and there a thin vertical seam of quartz. This grades at an undetermined depth into crystalline schist or gneiss.

The above profile illustrates the regional morphological characteristics. The mechanical and chemical analyses of samples of a profile of Cecil fine sandy loam collected by C. F. Marbut in Hall County, near Lula, are given in table 8. The area is included with Cecil sandy loam, eroded phase, on the map.

¹⁰ BYERS, HORACE G., ALEXANDER, LYLE T., and HOLMES, R. S. THE COMPOSITION AND CONSTITUTION OF THE COLLOIDS OF CERTAIN OF THE GREAT GROUPS OF SOILS. U. S. Dept. Agr. Tech. Bul. 484, 39 pp. 1935.

¹¹ MARBUT, C. F. SOILS OF THE UNITED STATES. U. S. Dept. Agr., Atlas of American Agriculture, pt. 3, Adv. Sheets No. 8, 98 pp., illus. 1935.

¹² JOFFE, JACOB S. PEDOLOGY. With an introduction by . . . Curtis F. Marbut. 575 pp., illus. New Brunswick, N. J. 1936.

¹³ HOLMES, R. S., and EDGINGTON, GLEN. VARIATIONS OF THE COLLOIDAL MATERIAL EXTRACTED FROM THE SOILS OF THE MIAMI, CHESTER, AND CECIL SERIES. U. S. Dept. Agr. Tech. Bul. 229, 24 pp., illus. 1930.

TABLE 8.—Composition of Cecil fine sandy loam near Lula, Hall County, Ga.¹

CHEMICAL

Sample No.	Horizon	Depth	SiO ₂	TiO ₂	Fe ₂ O ₃	Al ₂ O ₃	MnO	CaO	MgO	K ₂ O	Na ₂ O	P ₂ O ₅	SO ₃	Ignition loss	Total	N	CO ₂ from carbonates
		<i>Inches</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
28911.....	A	2- 10	a 89.89	0.61	1.23	4.49	0.017	0.04	0.01	0.82	0.12	0.01	0.04	2.52	99.80	0.029	
			b 92.21	.63	1.26	4.61	.017	.04	.01	.84	.12	.01	.04		99.79		
28912.....	B	12- 40	a 57.59	.49	5.63	24.95	.016	.30	.77	1.11	.11	.02	.11	9.25	100.35	.008	
			b 63.45	.54	6.20	27.49	.018	.33	.85	1.22	.12	.02	.12		100.36		
28913.....	C ₁	40- 60	a 64.31	.39	4.17	21.06	.016	.28	.32	1.31	.02	(²)	.06	8.15	100.09	.007	
			b 70.02	.42	4.54	22.93	.017	.30	.35	1.43	.02	(²)	.07		100.10		
28914.....	C ₂	60-100	a 66.50	.29	3.37	20.64	.020	.30	.44	1.80	.04	.01	.05	6.93	100.39	.006	
			b 71.45	.31	3.62	22.18	.020	.32	.47	1.93	.04	.01	.05		100.40		
28915.....	C ₃	150+	a 68.64	.24	2.88	18.29	.034	.36	.76	3.12	.17	.04	.04	5.70	100.27	.002	
			b 72.79	.25	3.05	19.39	.036	.38	.81	3.31	.18	.04	.04		100.28		

MECHANICAL

Sample No.	Horizon	Depth	Fine gravel (diameter 2-1 mm.)	Coarse sand (diameter 1-0.5 mm.)	Medium sand (diameter 0.5- 0.25 mm.)	Fine sand (diameter 0.25- 0.1 mm.)	Very fine sand (diameter 0.1- 0.05 mm.)	Silt (diameter 0.05-0.005 mm.)	Clay (diameter 0.005-0.000 mm.)	Total mineral constituents
			<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
28911.....	A	2- 10	1.6	10.2	12.2	36.2	16.2	17.0	6.5	99.9
28912.....	B	12- 40	.5	6.6	4.5	16.8	9.5	23.3	38.8	100.0
28913.....	C ₁	40- 60	2.0	10.0	5.8	22.0	12.6	24.1	23.5	100.0
28914.....	C ₂	60-100	1.9	12.0	6.7	28.7	12.2	25.3	13.2	100.0
28915.....	C ₃	150+	5.4	25.3	12.8	34.2	11.4	7.5	3.3	99.9

¹ Table from SOILS OF THE UNITED STATES. U. S. Dept. Agr., Atlas of American Agriculture, pt. 3, p. 57. Sample collected by C. F. Marbut; chemical analyses by G. J. Hough and G. Edgington; mechanical analyses by A. A. White.

² Trace.

NOTE.—The letter *a* indicates whole soil, oven-dried at 110° C.; *b*, whole soil, calculated to mineral constituents only.

In comparing the mechanical and chemical analyses given in table 8 with similar data in the Atlas of American Agriculture, Marbut writes:

The surface soil with 75 percent sand of all classes and only 6.5 percent of clay is a very light textured sandy loam. The B horizon, however, has 39 percent clay and 62 percent of silt and clay combined. From a depth of 40 inches downward the percentage of clay decreases to 3 percent at a depth of 12 feet, and at this depth the materials consist almost entirely of disintegrated rock.

This profile differs from most of the Cecil profiles already examined in the low percentage of iron oxide, the maximum being 6.2. The percentages of alumina in the B, the maximum in the profile, is above an average for the profiles already examined.

The percentage of CaO is low but is present in all horizons higher than a mere trace. The percentage of potash is moderate to a depth of 8 feet. At 12 feet it is relatively high, 3.3 percent, indicating the presence of undecomposed minerals.

Molecular ratios showing important chemical relationships in Cecil fine sandy loam are given in table 9.

TABLE 9.—Molecular ratios, showing important chemical relationships in Cecil fine sandy loam near Lula, Hall County, Ga.

Sample No.	Horizon	Depth	Molecular ratios ¹		
			sa	sf	ba
28911.....	A	<i>Inches</i> 2-10	34.00	193.8	0.256
28912.....	B	12-40	3.90	27.1	.077
28915.....	C ₃	150+	6.38	63.2	.225

¹ Molecular ratios are designated by the following symbols:
 $sa = \frac{SiO_2}{Al_2O_3}$; $sf = \frac{SiO_2}{Fe_2O_3}$; and $ba = \frac{CaO + K_2O + Na_2O}{Al_2O_3}$

Marbut continues:

The percentage of alumina in proportion to silica in B is practically twice that in C₃, and that in A is only a fifth of that in C₃. The relative number of molecules of silica in B, however, is about 15 percent less than in C₃, so that, as in the other Cecil profiles, a small part of this increase of alumina in B must be ascribed to loss of silica. The sf ratio in B is less than in C₃. Since the loss of silica in B over that in C₃ affects both alumina and iron oxide to the same extent, it is clear that here again, as in the Cecil profiles already examined, iron oxide has accumulated in the B to a greater extent than alumina. The maximum percentage of both is found in the same horizon rather than in different horizons or at different depths as was the case with some of the soils of the coastal plain.

Mechanical analyses of Madison sandy loam are given in table 10.

TABLE 10.—Mechanical analyses of Madison sandy loam in Hall County, Ga.

Sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	<i>Inches</i>	<i>Percent</i>						
259538.....	1-7	7.5	14.4	10.3	19.4	10.8	25.8	11.8
259539.....	7-11	4.4	9.1	8.9	20.5	12.7	29.9	14.5
259540.....	11-14	5.2	7.9	6.1	12.7	7.9	22.6	37.6
259541.....	14-21	5.4	6.8	4.3	8.3	4.8	14.9	55.5
259542.....	21-36	6.4	9.5	5.5	10.0	6.4	20.0	42.2
259543.....	36-72	5.2	10.8	5.6	11.8	10.3	27.4	28.9

SUMMARY

Hall County is in north-central Georgia, in the upper part of the Piedmont Plateau. Gainesville, the county seat, is about 50 miles northeast of Atlanta. The elevation of the county ranges from 800 to more than 2,000 feet above sea level. Dissection is thorough throughout, as the larger streams have carved deeper valleys and the numerous smaller tributaries afford excellent to excessive drainage. Most of the land has rolling to hilly relief, although a few areas are almost level. Rainfall is ample and well distributed, and the temperature is mild to moderate.

Both climate and soils favor a diversified agriculture. The present agriculture is based primarily on the production of cotton as the cash crop. Corn, however, occupies the largest acreage, covering almost one-half of the cultivated land. Minor crops are wheat, oats, rye, and such hay crops as soybeans, cowpeas, lespedeza, and crimson clover. Corn is grown largely to supply feed for work animals, fatten hogs, and furnish meal for home consumption. Apples and peaches are grown on a commercial scale in the eastern part of the county. More grasses and hay have been grown in recent years, and this is leading in the right direction to the raising of more cattle and to the extension of the production of milk. Many kinds of garden vegetables suitable to this climate can be grown successfully.

About one-third of the total land area is in crops. The rest is in idle or abandoned land that once was cleared and cultivated and is now reforested to loblolly or old-field pine. Both sheet and gully erosion are pronounced on many of the once-cultivated areas—in fact many areas now cultivated are badly eroded. Only a very small acreage of the soils remains in a virgin condition, and original forests of oaks and shortleaf pine are still standing in very few places.

On the accompanying soil map are 25 soil types, phases, and miscellaneous land types. These have been broadly classed in six main groups, based on rather definite soil characteristics, relief (lay of the land), and drainage conditions, as follows: (1) Gray sandy soils of the uplands, (2) red clay loam soils of the uplands, (3) miscellaneous soils of the uplands, (4) red to gray soils of the terraces, (5) brown to gray soils of the first bottoms, and (6) rough broken land.

Cecil sandy loam, Appling sandy loam, Madison sandy loam, and Louisa-Madison gravelly fine sandy loams of the first group have gray or light-brown mellow friable sandy loam surface soils over red or yellowish-red rather heavy clay subsoils. These soils are best suited to the production of cotton under conditions of boll weevil infestation, and they produce most of the cotton grown. A wide variety of other crops are also adapted to these soils. The eroded and hilly phases of these soils are used for the same crops but are more difficult and slightly more expensive to handle.

Cecil clay loam, Davidson clay loam, and Madison clay loam, together with their hilly phases, comprise the second group, or the so-called red lands of the county. They have red or reddish-brown heavy surface soils and stiff brittle clay subsoils. They are inherently strong and productive and are better suited to the production of grain, grasses, and clover than are the light-textured sandy soils. Cotton does not mature early on these soils and is subject to the

ravages of the boll weevil. The hilly phases, if properly seeded to grasses or planted to kudzu, afford good pasturage for cattle.

Louisburg sandy loam, Worsham sandy loam, and Mecklenburg gravelly loam, shallow phase, are classed as miscellaneous soils of the uplands. Their soil characteristics and drainage conditions vary widely. Very little of the Louisburg and Worsham soils is cultivated. The Worsham soil, when seeded to the proper mixture of grasses, affords excellent pasture.

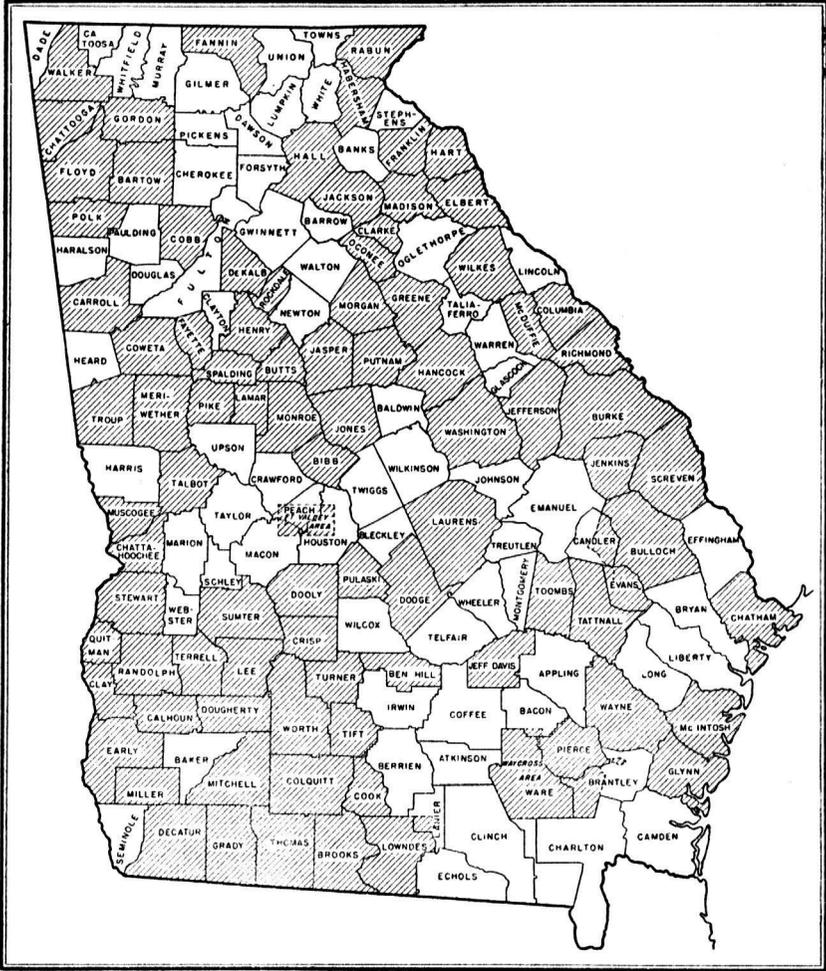
Hiwassee loam, Wickham fine sandy loam, and Altavista fine sandy loam are red to gray soils developed on terraces and second bottoms. They are good, strong, agricultural soils, and are devoted to cotton, corn, and hay.

Of the brown to gray soils of the first bottoms, Congaree fine sandy loam is the best drained and is used for the production of corn and hay. Chewacla silt loam is not so well drained as the Congaree soil and is used mainly for hay crops, although in dry seasons corn does well. Wehadkee silt loam and alluvial soils (Congaree soil material) if drained and reclaimed would make good pasture.

The extensive areas of rough broken land (Cecil-Madison soil materials) are too hilly and steep for general farming, and their best use is for forestry and wildlife.

Large areas of abandoned land can be purchased at reasonable prices. Some of this land could be developed into farms, particularly of the subsistence type. Many abandoned areas of inferior soils could profitably be developed as pasture land or could be reforested. This is a healthful locality, and good water for both people and cattle is easily obtained. Because of the wide variation in soils, diversified farming can be practiced. More cattle, poultry, and hogs could easily be raised in the subsistence-farming program.





Areas surveyed in Georgia, shown by shading.

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