

# SOIL SURVEY OF CLEVELAND COUNTY, NORTH CAROLINA.

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## DESCRIPTION OF THE AREA.

Cleveland County lies in the south-central part of the western half of North Carolina, the South Carolina line forming its southern boundary. It is bounded by Rutherford County on the west, by Burke County on the north, and by Lincoln and Gaston counties on the east. Its length is approximately 27 miles. Its width on the south boundary line is 25 miles, and on its northern boundary about 10 miles. The included area is 468 square miles, or 299,520 acres.

The upland consists of a broad plain of moderate elevation sloping gently southward, dissected by the valleys of a system of perennial streams and intermittent drainage ways that ramify all parts of the county.

Cleveland County includes three fairly distinct topographic divisions. About 87 per cent of its area consists of rolling to hilly lands. These occur throughout all parts of the county except a belt crossing the southeastern part. Several small, gently rolling areas occur through this rolling country, principally in the vicinity of Toluca, along the crest of the divide between Buffalo Creek and First Broad River, extending from Belwood south to the State line, and in a small area south of Lattimore. The more rolling sections occur in the northern part of the county near Casar and in the southwestern part along Broad and First Broad Rivers. The upper stream slopes are as a rule gently rolling, but they become rolling and occasionally precipitous as the larger streams are approached.

An area of gently rolling to rolling land occurs in the southeastern part of the county. It occupies a wedge-shaped belt which crosses the east county line with a width of about 8 miles, reaching from Waco south to a point near the town of Kings Mountain and extending to the southwest, occupying roughly the country between Buffalo Creek and the Southern Railroad. It narrows down to an approxi-

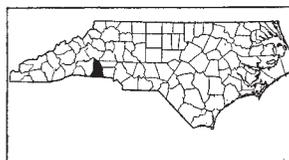


FIG. 7.—Sketch map showing location of the Cleveland County area, North Carolina.

mate width of 3 miles where it crosses the State line. The underlying rocks, mainly white, coarse-grained granite and mica schists, are comparatively soft, and the surface in general is slightly lower than that of the greater part of the county.

The topography of the mountain ridge along the northern county line and its various outlying ridges and foothills ranges from steeply rolling to rough and precipitous along the upper slopes of the higher ridges and peaks. These rise abruptly to heights of 200 to 1,500 feet above the adjacent Piedmont region.

The determined elevation of the ridges above sea level ranges from 1,200 to 1,300 feet in the northern part of the county to about 800 feet in the southern part. The depth of the valleys below the adjacent upland crests ranges from a few feet to 200 feet or more. There are numerous conspicuous elevations, especially in the mountain range along the northern boundary of the county. This range is part of the Southern Mountains. The highest elevation here is Benn Knob, which has an altitude of 2,894 feet. Various outlying hills, including Old Sheep Knob, Carpenters Knob, and Buffalo Knob, with elevations above sea level of 1,500, 1,600, and 1,400 feet, respectively, occur in the northeastern part. Kings Mountain, in the southeastern part, reaches a height of 1,705 feet at its highest point, called the Pinnacle. Two prominent hills, Jollys Mountain and Abes Mountain, with elevations of about 1,000 feet, occur in the southwestern part of the county near the Broad River. With the exception of the greater part of the hilly to mountainous sections and some of the steeper slopes along the larger stream courses, all the area of the county is cultivable, but the steeper slopes erode under cultivation unless careful attention is given to the maintenance of hillside terraces and to the growing of soil-binding crops.

The streams throughout the county flow in narrow valleys. In their upper courses they are usually bordered by gently rolling slopes; along their lower courses the slopes are rolling and in places precipitous. Their bottom lands are inextensive and interrupted, the upland slopes frequently reaching to the stream bed. These bottom lands are subject to overflow, which occasionally is destructive.

The county is ramified by an extensive drainage system, reaching out in all directions. Some areas along the wider ridges, especially in the southeastern part of the county, have only fair to good surface drainage, but over the greater part of the upland the run-off is so rapid as to cause destructive erosion. Most of the streams are fed by springs, and even the smaller branches flow continuously throughout the year. All the streams have rapid currents and af-

ford vast potential water power. Numerous gristmills, gins, and pumps, and several cotton mills are operated by water power.

A never-failing supply of excellent spring or well water is available in most parts of the county. There are a number of mineral springs, the water from which is widely used for medicinal purposes.

Cleveland County was established from parts of Rutherford and Lincoln counties in the year 1841, Shelby being made the county seat. In 1915 about 6 square miles of territory, including the eastern part of the town of Kings Mountain, was annexed from Gaston County. The first permanent settlements in this region were made during colonial times. The early settlers were mostly Scotch-Irish and Germans from Europe, but many settlers came from the older provinces to the northeast. According to the census, Cleveland County had a population of 12,696 in 1880, 20,394 in 1890, 25,078 in 1900, and 29,494 in 1910. A little more than one-fifth of the population is negro. The rural population, which includes all the inhabitants outside the town of Shelby, is reported as 26,367, averaging 54 persons per square mile. Shelby had a population of 3,127 in 1910 and Kings Mountain a population of 2,218. Other places of local importance are Lawndale, Lattimore, Grover, Mooresboro, and Waco.

There are fifteen cotton mills in operation in Cleveland County, eight at Kings Mountain, four at Shelby, and one each at Lawndale, Stubbs, and Double Shoals. There are cottonseed-oil mills at Kings Mountain, Shelby, and Lattimore. The mill at Shelby is operated in conjunction with a fertilizer plant, and that at Lattimore has recently begun the manufacture of soy-bean-oil products. There is a roller mill at Kings Mountain, and another at Shelby. Numerous small sawmills and shingle mills are operated throughout the county.

There are many more or less valuable mineral deposits in the county, including iron, gold, tin, monazite, graphite, and mica. Some of these have been worked at different times.

Railroad transportation facilities are good in the southern half of Cleveland County. The main line of the Southern Railway from Washington to Atlanta traverses the southeastern part of the county, passing through Kings Mountain and Grover. A branch line extends north from Blacksburg, S. C., to Shelby, and thence west. The Wilmington to Rutherfordton branch of the Seaboard Air Line Railway traverses the county east and west, passing through Waco, Stubbs, Shelby, Lattimore, and Mooresboro. A narrow-gauge road extends from Shelby through Double Shoals to Lawndale. The development of the northern part of the county has been seriously handicapped by the lack of good transportation facilities.

Cleveland County has a large mileage of graded sand-clay roads. The Charlotte to Asheville Highway passes through Kings Mountain, Shelby, and Mooresboro. The National Highway from Washington to Atlanta crosses the southeastern part, passing through Kings Mountain and Grover. The road work is done by townships and largely under bond issues.

Telephone service and rural mail delivery reach all parts of the county. Churches are located at convenient intervals. A good system of graded and high schools is maintained. There are important high schools at Boiling Springs and near Lawndale.

The numerous cotton mills and oil mills within the county furnish a market for the greater part of the cotton crop. The remainder finds a ready market in Charlotte. The creamery butter produced is sold by contract in the near-by cities and towns. Much of the produce, especially eggs, is shipped to New York City.

#### CLIMATE.

The climate of this region is moderate and healthful. The winter months are characterized by short periods of clear, cold weather alternating with periods of warm, cloudy days, terminating in rain and falling temperature. The soil freezes to only a shallow depth, but freezing is of sufficient frequency to have a beneficial effect upon fall-plowed land. The dates of the latest recorded killing frost in the spring and the earliest in the fall are May 10 and October 10, respectively. The average date of the last killing frost in the spring is April 10 and that of the first in the fall October 26. The average growing season is thus approximately 200 days in length and ample for the maturing of all the general farm crops. Under favorable conditions two crops of certain kinds, such as oats and corn, may be obtained in one season. Hardy vegetables can be grown during the winter. On the heavier lands especially it is necessary to grow the smaller balled varieties of cotton in order to insure maturity. The rainfall is well distributed through the year and is ample for production of all crops. The mean annual precipitation is 53.11 inches.

There is no Weather Bureau station in Cleveland County, but the local conditions differ little, if any, from the conditions at Caroleen, Rutherford County, about 20 miles southwest of Shelby, and the records of that station have been drawn on in compiling the appended table:

*Normal monthly, seasonal, and annual temperature and precipitation at Caroleen, Rutherford County.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year. (1904).	Total amount for the wettest year. (1901).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	41.2	75	6	5.14	3.51	8.94
January.....	41.1	80	7	3.59	2.08	2.65
February.....	40.7	76	4	5.18	3.75	2.21
Winter.....	41.0	80	4	13.91	9.34	13.80
March.....	52.4	94	12	4.91	3.80	5.10
April.....	58.3	91	20	3.80	1.13	8.45
May.....	68.8	99	32	3.77	3.00	9.00
Spring.....	59.8	99	12	12.48	7.93	22.55
June.....	75.0	103	44	6.34	4.84	10.62
July.....	78.3	104	56	4.31	4.00	4.86
August.....	77.5	101	50	6.59	7.74	14.20
Summer.....	76.9	104	44	17.24	16.58	29.68
September.....	72.0	98	40	4.02	0.82	7.21
October.....	59.8	92	40	2.99	0.07	1.18
November.....	50.0	82	15	2.47	4.10	0.95
Fall.....	60.6	98	15	9.48	4.99	9.34
Year.....	59.6	104	4	53.11	38.84	75.37

#### AGRICULTURE.

Agriculture has always been the principal industry of Cleveland County. The early settlers made their homes along the larger streams in the central and southern parts of the county. The abundant grazing favored stock farming, and a comparatively large number of cattle, sheep, and hogs were raised. The live-stock products were marketed in the eastern cities. Corn, wheat, tobacco, flax, indigo, hemp, sweet potatoes, and other vegetables and fruits were the principal crops at first. With the invention of the cotton gin cotton quickly became the principal cash crop.

An extensive system of farming gradually developed. Large plantations were cleared and put in cultivation. When fields be-

came impoverished they were abandoned. Large areas of land now supporting a growth of old-field pine were at one time in cultivation. The early plantations were practically self-supporting, all the corn, meal, flour, meat, milk, butter, wool, and the feed necessary for the work stock, sheep, and hogs being produced on the farm. Clothing, leather goods, and implements were largely made at home. Every farm was supplied with a horsepower cotton gin and screw compress, and flour and meal were ground by water-power mills.

The Civil War had a disastrous effect upon agriculture through the demoralization of labor conditions and the loss of capital. During this period an entire readjustment of farm practices took place. Crops requiring the least labor and outlay and most readily convertible into cash were grown, and cotton became almost the only cash crop. The acreage in cotton has gradually increased, and it is at present the most important crop. There has been also a steady increase in the acreage of corn, wheat, forage crops, sorghum, sweet potatoes, and minor subsistence crops. The farms in general are much nearer self-supporting than those nearer the center of the Cotton Belt, where cotton is grown almost to the exclusion of the subsistence crops.

In 1909 there were 38,876 acres in cotton, which produced 15,568 bales, or an average of 0.4 bale per acre. This is slightly above the average yield for the Cotton Belt. Within recent years the production of cotton has considerably increased. Approximately 22,000 bales were produced in 1913, 23,596 in 1914, and 20,187 in 1915. Practically all the cotton produced is short staple. Kings Improved and Cleveland Big Boll are the leading varieties.

Corn has gradually increased in acreage from 31,339 acres in 1879 to 41,471 acres in 1909. The production in 1879 was 390,281 bushels and in 1909, 564,449 bushels. Corn exceeded cotton in acreage up to and including the time of the last census. The crop is all used on the farm, being fed to work stock and hogs or ground into meal. Notwithstanding the large acreage in this crop, it is estimated that little more than half of the corn used locally is produced in the county.

Wheat has long been an important crop. According to the census, 86,317 bushels were produced in 1859. In 1879 there were 11,116 acres in wheat. The acreage gradually increased until about 1899, when there were 19,118 acres in wheat, producing 96,270 bushels. Later, owing to an invasion by the Hessian fly, the acreage dropped rapidly, there being only 9,046 acres in this crop in 1909. During the last few years, owing to the high price of flour and to the need of a small grain in rotations, the acreage in wheat has been greatly increased, and at present probably exceeds that of 1899. All the crop is

thrashed and milled for home use. A large quantity of flour is shipped into the county annually.

The acreage in oats has steadily decreased during the last 40 years. According to the census, in 1879 there were 10,959 acres in oats, producing 62,211 bushels; in 1889, 8,291 acres, producing 55,591 bushels; in 1899, 2,604 acres, producing 15,660 bushels; and in 1909, 6,052 acres, producing 66,504 bushels. All the crop is fed on the farm, part being thrashed and part fed in the bundle.

Hay and forage crops are becoming increasingly important. In 1909 there were 4,818 tons of hay and forage produced. This is all used locally. Cowpea vine, sorghum, herd's-grass (redtop), red and crimson clover, corn fodder (the blades stripped from the stalk), and oats-vetch mixtures comprise the greater part of the hay and forage crop.

There were 884 acres in sorghum in 1909. This crop is grown principally for making sirup for home use. Tobacco was at one time a crop of some importance, over 24,000 pounds being produced in 1859. There is only a small acreage in this crop at present, but a number of farmers expect to begin the commercial production of tobacco within the next year or two. In 1909 there were 1,291 acres in cowpeas, from which 7,783 bushels of seed were gathered. The acreage of this crop is rapidly increasing. The vines make excellent hay, the seed is valuable for food or for sale, and the growing of the crop has a beneficial effect upon the soil.

The minor crops, grown for home use or only partly for market, are sweet potatoes, Irish potatoes, tomatoes, and other vegetables for canning or for home use, early apples, cherries, peaches, plums, pears, muscadine grapes, cantaloupes, watermelons, strawberries, blackberries, soy beans, velvet beans, vetch, alfalfa, rye, and peanuts. All these crops succeed.

Dairying has made more progress than the other live-stock industries. Nearly every farmer keeps one or more milch cows to provide milk and butter for home use, and a considerable number have herds of 10 to 20. There are two creameries in the county, one at Mooresboro and one at Shelby, with a combined output of about 250,000 pounds of butter annually. The greater part of the product is shipped out of the county. These creameries receive milk and cream from a comparatively large territory. A considerable amount of country butter is handled by local dealers, the production being sufficient to supply the home market and leave a surplus for export.

Nearly every farmer produces sufficient pork for home use, and there is an occasional surplus for sale on the local market. Most of the hogs are grades or nondescripts, but there are a few purebred animals. The Duroc-Jersey, Poland-China, Ohio Improved Chester,

Tamworth, and Berkshire are the principal breeds represented. Sheep raising was at one time an important industry, but the number of sheep has gradually decreased from 8,342 in 1880 to 151 in 1910. Nearly every farmer keeps a flock of poultry. There are two poultry farms near Shelby, each of which maintains 500 hens. A considerable quantity of poultry and eggs is exported from the county annually.

The natural adaptation of the soils of Cleveland County to pasture, hay, and grain crops, the favorable climate, and the excellent water supply make conditions admirably suited to stock farming. A number of farmers are planning a system of farming in which the production of live stock may be combined with the growing of cotton as the principal cash crop. The greater part of Cleveland County is particularly well suited to pasture grasses. Alsike and white clover, orchard grass, Italian rye-grass, tall meadow oat-grass, redtop, Dallas grass, Bermuda grass, lespedeza, and other native grasses are uniformly successful. The 1910 census reports approximately 130,000 acres, or 41.6 per cent of the total area of the county, as improved land, leaving about 182,500 acres in woodlots, forested areas, and lands lying idle. The greater part of the unused land is covered with a second growth of pine and hardwoods. Probably more than 75 per cent of the Piedmont section of the county is cultivable, and all but the steepest, stony areas are well suited to use as pasture land.

There is some though not intensive specialization of farming in certain sections of the county. Commercial dairying is in general confined to the central-western part of the county, largely as a result of the location of markets. The importance of corn and small grains as compared with cotton is greatest in the northern part of the county, owing largely to higher altitude and its effect upon climatic conditions. In normal years the Buffalo Creek section is a heavy corn-producing area.

The adaptation of the different soils to certain crops is recognized to a considerable extent. Small-bolled, early maturing varieties of cotton are commonly grown on the heavy "red lands," since cotton matures late on these heavy soils. Sorghum, wherever possible, is grown on the sandy soils, as the sirup is superior in quality to that produced on the "red lands," owing to the rank growth made on the latter. Peanuts, tobacco, sweet potatoes, watermelons, and cantaloupes are considered best adapted to the sandy soils. The bottom lands are in general given over to corn, small grain, and hay and pasture grasses.

Farming methods are gradually improving throughout the county. Most of the land is plowed to a depth of only 4 to 6 inches, but a number of the better farmers have gradually increased the depth of

plowing to 8 to 14 inches. In many cases the land is plowed deep in the fall and seeded to a winter cover crop. A number of the better farmers are improving their soils through the incorporation of organic matter by growing legumes and winter cover crops. Erosion, which has been very destructive in places, especially on the "red lands," is being checked on many farms through deeper plowing, the incorporation of organic matter in the soil, and terracing. Two general forms of terraces are used. The broad cultivated terrace is rapidly gaining in favor on all except the most steeply rolling areas (Pl. XXXV, fig. 2). The old bank or permanent sodded terrace is most generally used on the more steeply rolling lands (Pl. XXXVI, fig. 1).

Owing to the heavy texture of much of the soil and the comparative diversity of crops grown, the larger farms are necessarily well equipped with heavy farm machinery. The equipment in use includes mowing machines, grain harvesters, corn harvesters, grain drills, corn planters, cotton planters, one-horse fertilizer distributors, lime sowers, manure spreaders, cane mills, two-horse walking or riding cultivators, separators, and stationary gasoline engines. There are several traction plows in the county, and a number of thrashing outfits. The mules and horses used as work stock range from medium to good in quality. Nearly all the work stock used is brought in from outside points. Many of the small farmers are handicapped by a lack of sufficient heavy machinery and work stock, which results in a small cultivated acreage and a low production per unit of man power. The barns and outbuildings are generally small, but sufficient to shelter the live stock and store the various crops. Hay is frequently stacked in the open. There are a number of silos in the county.

Until recent years little or no attention has been given to the systematic rotation of crops. Fields were planted either to corn or to cotton continuously for years. In the early days of agricultural development impoverished fields were abandoned and new areas put under cultivation. Later, as the country became more thickly settled and new land was no longer abundant and cheap, it was found profitable to alternate cotton and corn every few years and to grow a small grain following a number of years of continued clean cultivation. Grass or clover was sown in the small grain, a hay crop was grown the second year, and the land was used as pasture for an indefinite period. This cropping system prevails at present, although the more progressive farmers are trying out various rotations of clean-cultivated crops, small grains, and legumes in an effort to build up the productiveness of the soil and at the same time increase the profits from farming operations. The most commonly used rotation consists of cotton the first year, followed by a winter cover crop of crimson clover or rye sown at the last cultivation and turned

under the following spring; corn the second year, with wheat or oats sown in the fall; and wheat or oats the third year, followed by cowpeas broadcasted for hay or drilled where grown for the seed.

In 1909 practically 90 per cent of all the farms in the county used commercial fertilizers, at an average expenditure of \$43 each. There has probably been an increase in the amount spent in recent years commensurate with the increased acreage of cotton and corn. Cotton is almost invariably fertilized. From 200 to 400 pounds of a commercial fertilizer analyzing 8-2-2<sup>1</sup> or 8-3-3 is the most common acreage application. Some farmers use 100 to 200 pounds of 16 per cent acid phosphate with stable manure or 100 to 200 pounds of acid phosphate with 50 pounds of cottonseed meal. A number of farmers in the vicinity of Washburn have used raw rock phosphate, applying it with cottonseed meal or turning it under with a crop of cowpeas. Corn is fertilized in much the same manner as cotton, but is generally given lighter applications. From 50 to 100 pounds of nitrate of soda per acre is usually applied as a side dressing in June, in addition to the ready-mixed fertilizers. The small grains are generally given an acreage application of 100 to 200 pounds of acid phosphate at seeding time. Lime, mainly in the form of ground limestone, is used by a number of farmers in growing legumes. Applications range from 1 to 5 tons per acre. The expenditure for necessary fertilizer can be materially reduced by growing the legumes in rotation with other crops and by plowing under winter cover crops.

Owing to the steady demand for labor by cotton mills and in lumbering operations, much of the work on the smaller farms is performed by the members of the family. Much hired labor is used by the larger farmers. The laborers are mainly negroes. Farm wages vary from \$12 a month with board to \$20 a month with house, firewood, and garden. Day labor usually brings \$1 a day. Woodchoppers receive 50 cents a cord. Cotton pickers receive an average of 50 cents per 100 pounds of cotton picked.

The census of 1910 reports the average size of farms in Cleveland County as 65.2 acres, 32.2 acres of which are improved land. There are numerous farms of 20 to 30 acres, but a number of farms comprise 200 to 300 acres, and there are some holdings of 1,000 acres or more.

The percentage of farms operated by tenants increased from 29.2 in 1880 to 50.6 in 1910. About 87 per cent of the tenanted farms are rented on shares. Under the most common arrangement the landowner furnishes work stock, implements, seed, one-half the fertilizer, and a house and firewood, and receives one-half the crops. In some

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<sup>1</sup> Respective percentages of phosphoric acid, nitrogen, and potash.

cases the landowner furnishes the fertilizer and seed and the tenant furnishes the work stock, each receiving one-half the returns.

There has been a marked advance in the price of farm lands within recent years. Prices vary with the character of the soil, the state of productiveness, the farm improvements, and the location with reference to markets. Prices at present range in general from \$20 to \$100 an acre.

#### SOILS.

Cleveland County lies almost wholly within the Piedmont Plateau. Gilead Ridge, along the northwestern boundary, and various outlying hills, including Old Sheep Knob, Carpenters Knob, and Buffalo Knob, in the northeastern part, and Kings Mountain, in the southeastern part, are in the Appalachian Mountain province.

The underlying rocks can be classed in three principal groups, each possessing markedly different characteristics and giving rise to different groups of soils. Granitic rocks occur throughout the Piedmont section of the county. Talcose, chloritic, and micaceous schists occur principally in the mountainous sections and scattered through the Piedmont division. Diorites are encountered principally near the town of Kings Mountain, and are of very small extent. The different groups of rock are intricately associated, and in only a few sections, except where the diorites predominate, does the material derived from one class of rocks occur unmodified by material from either of the others. Veins of quartz are of frequent occurrence, but this rock, owing to its resistant nature, contributes little to soil material. Quartz fragments are abundant over the surface of many areas, especially in the granite belt.

The granites may be separated into two general classes. A dark-colored, medium-grained granite, high in content of orthoclase feldspar (a potassium aluminum silicate), occupies the whole granite area, with the exception of a belt crossing the southeastern part of the county. Under the influence of weathering this rock gives rise to red clay (Cecil material). A coarse-grained, soft, light-colored granite, also probably high in content of orthoclase feldspar, occurs through the belt of gently rolling country in the southeastern part of the county. This granite upon disintegration and decay gives rise to yellow and red mottled clay (Appling material).

The diorite, a dark-colored, fine-grained rock, locally known as "iron rock," contains among other minerals plagioclase feldspar, a silicate of soda, lime, and aluminum. For the most part it weathers into a sticky, plastic, greenish-yellow or greenish-brown clay classed as Iredell material.

The schists consist of fine-grained rocks of finely foliated structure, which in their unweathered state have a grayish, bluish, greenish, or purplish color. In the southeastern corner of the county, over the lower end of Kings Mountain and the surrounding Piedmont region, the underlying rocks are prevailingly fine-grained mica schists and gneiss. These schists have a more massive structure, a fine texture, and a more lustrous appearance than those encountered elsewhere in the county. Their color ranges from pink to bluish gray. Huge rounded bowlders of ferruginous conglomerate, made up largely of sandstone pebbles cemented with iron, occur on the surface over the lower end of Kings Mountain in the vicinity of Dixon Gap. The soil formed through the decay of the schists consists largely of red silt and clay. It is identified as Louisa material in the Piedmont region and as Talladega in the Appalachian Mountain region.

The granite rocks have decayed deeper than the other formations, the depth to bedrock ranging from 3 to 20 feet or more. On some of the steeper and lower slopes and on ridges and knolls the soil has been washed off and outcrops of granite occur. Throughout the schist areas the soil material is prevailingly shallow. Disintegrated schist is frequently encountered at a depth of 15 to 20 inches, and bedrock occurs at depths ranging from 30 inches to 4 or 5 feet. Large rock fragments and bedrock outcrops are of general occurrence over the rougher areas. The diorite has weathered to an average depth of 2 to 4 feet.

The stream bottom soils consist of alluvium washed from the uplands. At every overflow additional material is brought to the bottoms, or that already there is shifted from place to place, so that the bottom-land soils are still in process of formation. They are included in the Congaree series and Meadow (Congaree material).

The Cecil and Appling series include residual soils derived mainly from granite, with intrusions of schist, gneiss, and diorite. The types in the Cecil series are characterized by grayish to reddish soils and heavy but friable red clay subsoils. The surface ranges from gently to steeply rolling, and drainage is good.

The Appling soils are characterized by light-grayish surface soils and heavy, friable, mottled yellow and red, clay subsoils. The surface is smoother than that of the Cecil soils. The surface drainage is fair to good, but underdrainage is often deficient.

The Louisa and Talladega series include residual soils derived mainly from schists. The Louisa soils are characteristically grayish to reddish brown in color and of fine texture. The subsoils consist of greasy, friable, bright-red silty clay to clay. Disintegrated schist fragments are commonly encountered within the 3-foot section. The surface ranges from rolling to broken.

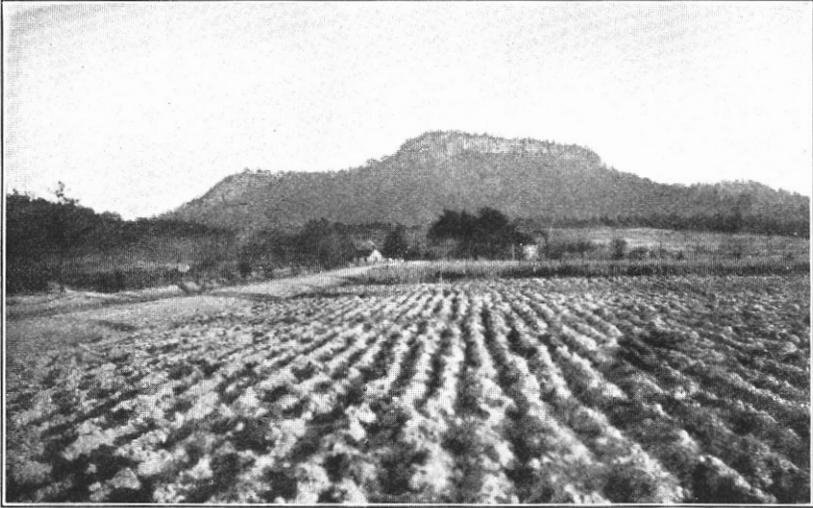


FIG. 1.—FALL PLOWED LOUISA LOAM. "THE PINNACLE" IN BACKGROUND.

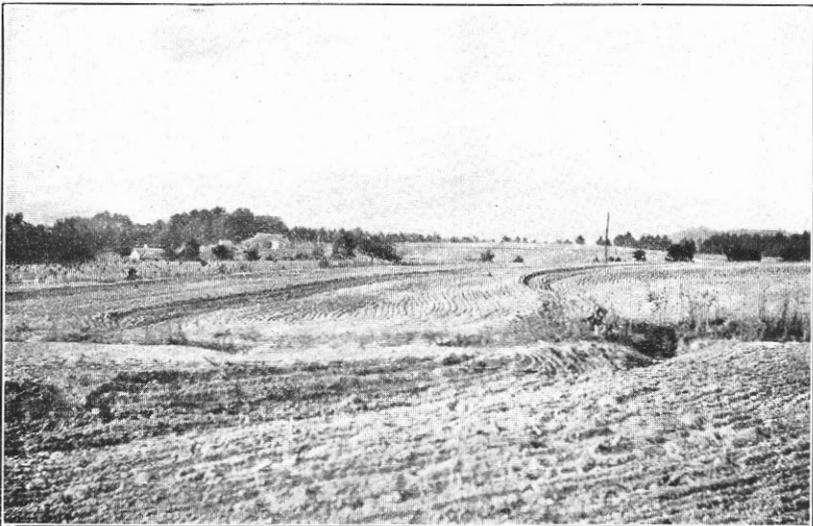


FIG. 2.—CULTIVATED TERRACES ON CECIL SANDY CLAY LOAM 2½ MILES SOUTHWEST OF CASAR. GILEAD RIDGE IN BACKGROUND.

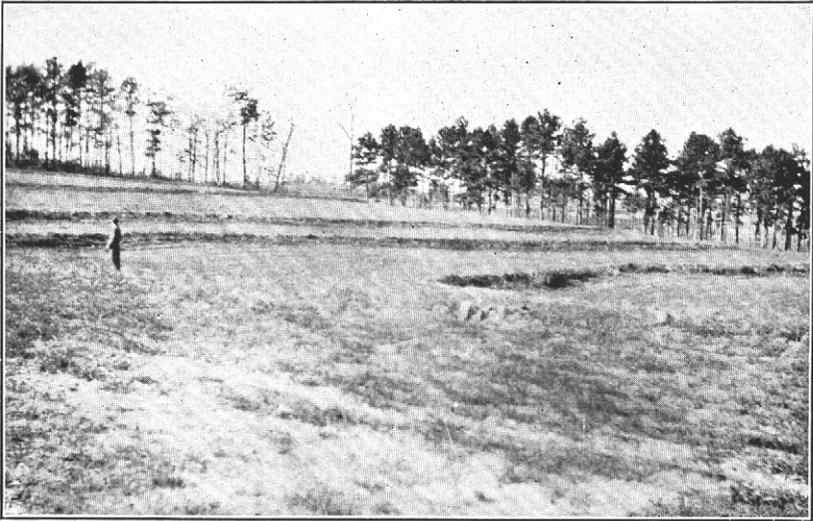


FIG. 1.—PERMANENT SODDED TERRACES ON CECIL SANDY CLAY LOAM NORTH OF SHELBY.

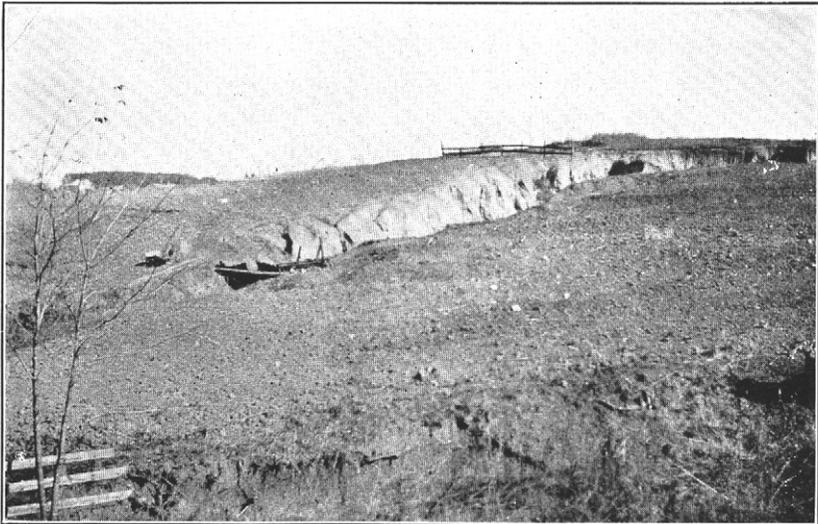


FIG. 2.—EROSION ON THE CECIL CLAY LOAM.  
Note wooden dam built to arrest gullying.

The Talladega series is differentiated from the Louisa principally on the basis of its occurrence in the Appalachian Mountain province. The surface soils are grayish to reddish brown. The subsoil is a greasy, friable, yellowish-red to bright-red silty clay to clay.

The Iredell series is characterized by gray to brown surface soils and yellowish-brown to greenish-brown, sticky clay subsoils.

The Congaree series includes brown to reddish-brown soils with brown subsoils. The Congaree soils are well drained between periods of overflow.

Meadow (Congaree material) occurs along streams, and includes areas of mixed soil in which the various types can not be differentiated.

Rough stony land comprises extremely rough and stony areas, some of which consist of ledges of solid rock.

The following table shows the actual and relative extent of the various soil types mapped in Cleveland County:

*Areas of different soils.*

Soil.	Acres.	Percent.	Soil.	Acres.	Percent.
Cecil sandy clay loam.....	123,264	41.1	Talladega stony loam.....	3,520	1.2
Cecil clay loam.....	63,104	21.5	Louisa silt loam.....	2,880	.9
Hilly phase.....	1,088		Louisa stony loam.....	2,688	.9
Cecil fine sandy loam.....	24,512	8.2	Cecil stony loam.....	1,856	.6
Appling sandy loam.....	23,808	7.9	Meadow (Congaree material)...	1,728	.6
Congaree fine sandy loam.....	19,264	6.4	Rough stony land.....	1,472	.5
Louisa loam.....	12,480	4.2	Iredell loam.....	128	.1
Louisa gravelly loam.....	9,024	3.0			
Appling very coarse sandy loam	8,704	2.9	Total.....	299,520	.....

CECIL STONY LOAM.

The Cecil stony loam, to a depth of 6 to 8 inches, consists of a grayish-brown to reddish-brown loam to sandy loam, underlain by a red, friable clay. Fragments of quartz, granite, and mica-schist are abundant over the surface, and numerous massive granite and quartz outcrops occur. Except in areas where the bedrock outcrops, the subsoil is comparatively free from rock material.

The Cecil stony loam occurs on the sharp crests of some of the narrower ridges, and along the steeper slopes of some of the larger streams. The type is widely distributed throughout the county, but its total area is small and it is of little importance from an agricultural standpoint. The larger areas occur along lower Broad and First Broad Rivers, along Sandy Run and Buffalo Creeks, south of the town of Kings Mountain, and below Camp Knob in the north-

western part of the county. The type has a rolling to broken surface and is well drained.

Practically all of the type is forested with pine, oak, and hickory. The stony surface makes cultivation difficult. A few of the less rolling areas have been partly cleared and are used as pasture. The stones have been removed from many of the smaller areas.

Land of this type sells at \$5 to \$20 an acre.

#### CECIL FINE SANDY LOAM.

The Cecil fine sandy loam consists of 6 to 8 inches of light-brown to grayish-brown fine sandy loam, underlain by red, friable clay. In occasional small depressions on the crests of the wider ridges and along the heads of small branches the soil is a light-grayish fine sandy loam, 6 to 8 inches deep, passing through pale-yellow fine sandy loam into a yellow, yellow mottled with red, or red, friable clay at 12 to 18 inches. Quartz fragments frequently occur in small quantities over the surface. The larger more gravelly areas are indicated by gravel symbols.

The Cecil fine sandy loam is developed largely on the crests of the wider ridges, along some of the more gentle slopes, and in depressions around the heads of small branches. It occurs mainly in small scattered areas throughout the greater part of the Piedmont section of the county. The surface ranges from undulating to gently rolling. Surface drainage is good, but underdrainage in some of the depressed areas is at times deficient.

The greater part of this type is cleared and in cultivation. The uncleared areas support a growth of pine, oak, hickory, persimmon, and dogwood. Cotton, corn, oats, and cowpeas are the principal crops. Cotton yields one-fourth to 1 bale, corn 10 to 40 bushels, and oats 15 to 40 bushels per acre. Some wheat is grown, but this soil is not considered so well adapted to the crop as the heavier members of the series. Sorghum yields well and gives an excellent quality of sirup. Bright-leaf tobacco and Spanish peanuts are grown to a small extent. Various garden crops, Irish potatoes, sweet potatoes, melons, muscadine grapes, small fruits, early apples, peaches, pears, and cherries are successfully grown. Crops mature comparatively early. The larger balled varieties of short-staple cotton, mainly the Cleveland Big Boll, are grown, though long-staple cotton is grown to a very limited extent on some farms.

This soil in general is not as productive as the heavier types of the series, but it is considered quite desirable on account of the ease with which it can be handled. It may be cultivated under a wide range of moisture conditions, and lighter implements and work stock can be successfully used on it than on the heavier soils. The

depressed areas of deeper, light-colored soils, however, remain soggy or wet during the early spring months, and their productiveness can not be so easily built up and maintained as the old lands.

Commercial fertilizers and barnyard manure are used for the leading crops. The same general grades of fertilizers are used as on the Cecil sandy clay loam, but usually at the rate of 50 to 100 pounds more per acre. Kainit under normal conditions might well be used on cotton in the depressed areas as a preventive of rust. Ground limestone is successfully used by a number of farmers in growing legumes. Applications vary from 1 to 5 tons per acre.

Land of the Cecil fine sandy loam sells at prices ranging from \$25 to \$100 per acre, depending largely on the location.

Excellent yields of cotton and corn can be obtained on this soil by good farming methods. Its productiveness can be increased in most cases by deeper plowing, the incorporation of organic matter through the turning under of coarse manures and cover crops, better cultivation, and a systematic rotation of the general farm crops. According to experiments carried on by the North Carolina Agricultural Experiment Station, the principal fertilizer element needed by this soil is phosphoric acid.<sup>1</sup>

#### CECIL SANDY CLAY LOAM.

The Cecil sandy clay loam, commonly known as "mixed gray and red land," consists of about 4 inches of grayish to reddish-brown sandy loam, passing through a reddish-brown loam to clay loam into a deep-red, brittle clay at about 6 inches. This red clay extends to depths of 4 to 20 feet. The presence of mica and schist material frequently gives the lower subsoil a greasy, slick appearance, similar to that of the Louisa soils. Numerous areas of sandy loam are included in small flats, around the heads of small branches, and above terraces where erosion has not removed the surface material. On the other hand, the sandy covering has been entirely removed in many small areas, leaving a clay loam surface soil. In many places the type is composed of intermingled areas of sandy loam and clay loam. Angular fragments of varicolored quartz occur more or less abundantly over the surface, and seams of white quartz are frequently encountered within the 3-foot section. Strata of schist occasionally lie near the surface, giving rise to patches of gravelly soil. Fragments of diorite also occur over the surface in places. The areas in which gravel is sufficiently abundant to affect cultivation are small and irregular. They are indicated on the map by gravel symbol. In places outcrops of granite occur. The more important of these are indicated on the map by rock-outcrop symbol.

<sup>1</sup> See The Bulletin, N. C. Dept. of Agr., Whole No. 206.

The Cecil sandy clay loam occurs throughout the greater part of the Piedmont section of the county. The largest areas are mapped in the northern and central parts. The surface ranges from gently to strongly rolling. The areas occur on the narrower ridges and on stream slopes, and many of the slopes are so steep that erosion is serious. Underdrainage is good, but the subsoil is retentive of moisture.

The Cecil sandy clay loam is important in the agriculture of the county. Probably 75 per cent of it is in cultivation. The remainder is largely forested with second-growth pine, various oaks, hickory, walnut, poplar, persimmon, wild cherry, and dogwood. Part of the type consists of abandoned fields. Cotton is the principal crop. A large total acreage is devoted to corn, wheat, oats, and cowpeas, and a considerable area to clover, soy beans, sorghum, and grasses. The crops of the latter group are grown mainly for stock feed and as a means of improving the soil. Crops mature moderately early. A few small fields are devoted to alfalfa, which seems to do well on this soil. Grasses, mainly Bermuda grass, orchard grass, red top, lespedeza, white clover, and various native growths, are easily started and maintained, and furnish excellent grazing. Vetch is grown to some extent in connection with oats as a winter cover crop. Garden vegetables, Irish potatoes, sweet potatoes, muscadine grapes, small fruits, peaches, pears, and early apples do well. A number of farmers on this soil in the central-western part of the county engage in dairying to some extent.

The Cecil sandy clay loam is a strong, durable soil and better methods of handling it are being taken up. The depth of plowing is being increased and more legumes are grown, to increase the organic content of the soil, to make it more drought resistant, and to check erosion. Fall plowing is extensively practiced. It has been found necessary to maintain terraces on this type. Moderately heavy work stock and implements are generally used. Commercial fertilizers and barnyard manure are used for the leading crops. Under normal conditions in the fertilizer market cotton land is generally given an acreage application of 150 to 300 pounds of an 8-2-2 or 8-3-3 preparation, 200 pounds of 16 per cent acid phosphate, or 200 pounds of acid phosphate and 50 pounds cottonseed meal. Corn receives an average application of 150 to 250 pounds of an 8-3-3 to 8-2-2 mixture at planting; 150 pounds of ready-mixed fertilizer at planting, and 50 to 100 pounds of nitrate of soda as a later side dressing; or 100 pounds of ready-mixed fertilizer at planting, and 100 pounds of nitrate of soda as a later side dressing. Wheat and oats are given an application of about 200 pounds of acid phosphate per acre.

Ground limestone, at the rate of 1 to 3 tons per acre, is used to an increasing extent in growing legumes.

Land values on the Cecil sandy clay loam range in general from \$25 to \$100 an acre. In the case of some of the more highly developed farms valuations reach \$150 an acre.

The Cecil sandy clay loam can be brought to a high state of productiveness. Perhaps the most important problem in handling it is the prevention of erosion on the steeper slopes. Some farmers maintain terraces, and the plant beds are in all cases run with the contours, but in many instances the terraces are not kept up properly and there is a tendency to cultivate too steep slopes. The steeper areas should either be properly terraced or used only for soil-binding crops, such as Bermuda grass and the various legumes.

The organic-matter content of this soil is in many cases low. Cowpeas or other legumes should be grown in rotation with such crops as corn and cotton. Fall plowing is beneficial, but all sloping areas should be subsequently seeded to some winter cover crop, such as wheat, rye, oats, vetch, or crimson clover, to prevent washing. The type has practically the same fertilizer requirements as the Cecil clay loam.

The natural adaptation of this soil to a large variety of hay and forage crops, such as lespedeza, white clover, Bermuda, and other grasses, makes it well suited to the raising of live stock, especially cattle and hogs. With an increase in the number of animals kept more manure would be available, and this is one of the best materials that can be used in building up this type. The Cecil soils have proved well suited to peaches in several other parts of the Piedmont Plateau, and there is little doubt that this fruit could be successfully grown commercially on this type in Cleveland County provided good market facilities were established.

The results of mechanical analyses of samples of the soil and subsoil of the Cecil sandy clay loam are given in the following table:

*Mechanical analyses of Cecil sandy clay loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
234517.....	Soil.....	5.5	9.8	7.0	38.3	16.9	14.4	8.7
234518.....	Subsoil.....	1.3	2.9	2.0	12.3	5.4	14.6	61.3

CECIL CLAY LOAM.

The Cecil clay loam, locally known as "red land," consists of a brownish-red, heavy loam to clay loam, 4 to 7 inches deep, underlain by a dull-red, heavy, brittle clay. The heavy clay subsoil material

commonly extends to a depth of 4 to 20 feet before the underlying rock is encountered. A layer of 2 or 3 inches of grayish to reddish-brown sandy loam frequently overlies the surface in the less rolling areas. So-called galled spots occur on some of the steeper slopes where the surface material has been eroded away, exposing the underlying red clay. Locally the subsoil has a greasy feel, due to the influence of the near-by schist rocks. Veins of quartz and schist come within the 3-foot section in places, giving rise to gravelly or stony areas, the larger of which are indicated on the map by symbols.

The soil in some small areas is called "push land," on account of its tendency to stick to the plow. It consists of a reddish-brown or dark-brown, heavy loam to clay loam, 10 to 12 inches deep, underlain by a dull-red heavy clay. This variation occurs in scattered small areas, usually in hillside depressions or in low, benchlike situations bordering the larger branches and creeks.

The Cecil clay loam occurs in broken areas throughout the county. It is most extensive in the central, southwestern, and southeastern parts. The type occupies gently rolling to rolling areas which become strongly rolling to hilly as the larger streams are approached. Some of the roughest areas occur on the slopes to the First Broad and Broad Rivers, in the southwestern part of the county. Erosion is serious on many slopes. Numerous fields have been badly gullied as a result of the continued growing of clean-cultivated crops without proper terracing.

Owing to its large extent and natural productiveness, this type is of considerable agricultural importance. Probably 85 per cent of it is in cultivation. The uncultivated areas are forested with second-growth pine, various oaks, hickory, walnut, persimmon, dogwood, and wild cherry.

The Cecil clay loam is especially adapted to corn, wheat, oats, rye, clover, cowpeas, sorghum, and grasses, but cotton is the leading cash crop. Cotton does well in favorable years, giving yields of one-third to 1 bale, and occasionally 2 bales, per acre. King's Improved and Culpepper, small to medium bodied and early maturing varieties, are most extensively grown. Corn yields range from 15 to 50 bushels per acre. Wheat is grown to a considerable extent. Ordinarily yields range from 5 to 25 bushels per acre, but occasionally 40 bushels per acre are obtained. Oats yield 15 to 40 bushels. Cowpeas give 1 to 2 tons of hay and 10 to 30 bushels of seed per acre. Clovers and grasses yield well. Crops of lesser importance which succeed are various garden vegetables, truck crops, alfalfa, vetch, soy beans, rye, and sorghum, and such fruits as early apples, cherries, peaches, pears, and various small fruits. A number of farmers on this soil in the central-western part of the county are engaged in dairying in a small way.

This type can not be plowed under as wide a range of moisture conditions as the lighter sandy soils. Terracing is necessary for the successful handling of this soil. The depth of plowing is gradually being increased and legumes are being grown more extensively to increase the organic-matter content of the soil, make it more retentive of moisture, and to check erosion. Fall plowing is extensively practiced. The soil can readily be brought to a high state of productivity.

In general, heavier implements and work stock are used on the Cecil clay loam than on any of the other soils of the county. The grades and amounts of fertilizer used are practically the same as on the Cecil sandy clay loam. It is reported that a number of farmers near Washburn are obtaining profitable results from the use of raw rock phosphate applied at the rate of about 1,000 pounds per acre in connection with barnyard manure or cottonseed meal.

Land values on the Cecil clay loam range from \$20 to \$100 an acre.

The principal needs of this soil are the prevention of erosion (see Pl. XXXVI, fig. 2) and the building up of the organic-matter content. Terraces should be carefully maintained, vegetable matter turned under, and the soil plowed deeper. Growing summer legumes and winter cover crops, the latter to be turned under, would increase the organic-matter and nitrogen content of the soil, promote a mellow tilth, and make the type more drought resistant and less liable to erosion. Deeper plowing would result in a better aerated seed bed. Deep fall plowing, followed by a winter cover crop, exposes the soil to the favorable effect of winter freezes, stores up a maximum amount of soil moisture, and relieves the congestion of farm work in the spring.

According to experiments<sup>1</sup> carried out by the North Carolina Agricultural Experiment Station on the Cecil clay loam at the Iredell Test Farm, the principal fertilizer constituents needed by this soil are phosphoric acid and nitrogen. Potash gave good returns when used with phosphoric acid, but was of little or no value when used alone or only with nitrogen.

Owing to its natural adaptation to numerous grazing and forage crops this soil is well suited to stock farming. Many of the steeper hillsides could be profitably used as pasture. In certain sections of the Piedmont Plateau the Cecil soils are successfully used for the commercial production of peaches. Dark export chewing tobacco is successfully grown on this soil in the northern part of this State and in Virginia.

*Cecil clay loam, hilly phase.*—Some scattered, steeply rolling areas of Cecil clay loam are mapped as a hilly phase. This phase is de-

<sup>1</sup> See The Bulletin, N. C. Dept. of Agr., Whole No. 206.

veloped mainly in the southwestern part of the county along the breaks bordering Broad and First Broad Rivers, and in the northwestern part along some of the larger creeks and branches. Probably 50 per cent of it is cleared and has been at some time in cultivation. Owing to the unfavorable topography and liability to erosion the greater part of the cleared areas have been abandoned and have grown up in broom sedge, Bermuda grass, and lespedeza, with a scattered growth of scrub pine and oak trees. The uncleared areas support a heavy growth of various oaks, hickory, and pine.

Owing to its rough topography this soil is unsuited to cultivation. It is well adapted to grasses and is generally used as pasture land.

#### IREDELL LOAM.

The Iredell loam is shown on the soil map by inclusion symbols in the color used for the Cecil clay loam. The type consists of a dull-brown or dark-gray, heavy loam, 6 to 8 inches deep, underlain by a dark greenish yellow to greenish-brown, impervious, plastic clay. Locally this soil is known as "bull-tallow land" or "blackjack-oak land."

The Iredell loam occurs principally in small areas near the town of Kings Mountain. One small area is mapped south of the confluence of Hickory and Little Hickory Creeks, about 4 miles south of Shelby.

The surface of the greater part of the type, in the vicinity of Kings Mountain, is undulating, while that of the smaller areas is rolling. Surface drainage ranges from medium to good, but the underdrainage, owing to the impervious structure of the subsoil, is deficient.

The greater part of the type is in cultivation. The uncultivated areas support a growth of pine, oak, and hickory. Cotton, corn, oats, and grasses are grown. Shallow-rooted plants, such as the small grains and grasses, are the most successful crops. Cotton yields one-third to three-fourths bale per acre in good years, but the crop frequently does not mature well. Corn gives fairly good returns.

This soil is handled in the same way as the Cecil types. It is a difficult soil to plow deeply, and if plowed when wet it clods badly. In parts of the Piedmont region, where there are large tracts of this soil, kainit in normal times has been used quite generally as a remedy for the rusting of cotton and the "frenching" (turning white) of young corn.

#### APPLING VERY COARSE SANDY LOAM.

The surface soil of the Appling very coarse sandy loam consists of a light-gray to brownish-gray very coarse sandy loam, extending to a depth of 6 to 8 inches. Gravel, composed chiefly of milk-white

quartz, occurs more or less abundantly over the surface. The surface soil in many places consists of a loam or fine sandy loam carrying a large percentage of fine gravel and very coarse sand. The subsoil consists of a yellow to yellow mottled with red, loose sandy clay, passing at a depth of 12 to 16 inches into a mottled yellow and red, friable silty clay or clay. The color of the subsoil is variable, ranging from pale yellow along some depressions and colluvial-like slopes, through the typical mottling of yellow and red, to a blending of yellow and red or pinkish in some exposed situations and on the more rolling slopes. Frequently the mottlings of red and yellow occur as large blotches or distinct strata. In many places the partly decomposed material of the underlying rocks, consisting of coarse-grained, soft, white granite and coarse-grained mica schists, gives a greasy feel to the subsoil, especially the lower part. The partly disintegrated bedrock frequently occurs within the 3-foot section, and occasionally outcrops on the crests of the sharper divides and along the steeper stream slopes.

The Appling very coarse sandy loam occurs in the southeastern part of the county, northeast of the main body of Appling sandy loam. It is developed along the county line from a point near Waco to the vicinity of Ebenezer Church, and north of El Bethel Church. The type occupies broad interstream divides and their slopes. Its topography varies from undulating to gently rolling and in places rolling. The drainage ranges from fair to good.

Most of the Appling very coarse sandy loam is in cultivation. The uncultivated areas support a forest growth consisting principally of pine, oak, hickory, walnut, persimmon, wild cherry, and dogwood. Cotton, corn, oats, clover, cowpeas, and grasses are the principal crops. Cotton yields one-third to 1 bale per acre. Cleveland Big Boll is the leading variety grown. Corn yields 10 to 40 bushels per acre. The type is considered fairly well suited to oats, yields of 15 to 50 bushels per acre being obtained. Red and crimson clover, rye, and cowpeas give good results. Some wheat is grown, but the crop is not often a success. Garden and truck crops are well suited to this soil. Sorghum produces sirup of excellent quality. Spanish peanuts and bright-leaf tobacco are successfully grown in a small way. Cherries, peaches, plums, early apples, muscadine grapes, and small fruits produce well.

Ready-mixed commercial fertilizers, commonly analyzing 8-3-3 or 8-2-2, are mainly used on this soil. Cotton ordinarily receives 200 or 400 pounds and corn 150 to 300 pounds per acre. Corn is frequently given a later side application of nitrate of soda. Some farmers mix their fertilizers at home, using barnyard manure, cottonseed meal, acid phosphate, nitrate of soda, and kainit. Oats and wheat land receive 150 to 200 pounds of acid phosphate per acre.

Lime is used to some extent on land intended for the legumes. This material might be more widely used to advantage to the grower of this class of crops.

Aside from some of the more gravelly or stony areas, this type is easily handled. Light implements and work stock are used. The soil in places, especially in the more nearly level areas, is said to be slow in drying out to a tillable condition in the spring. Following a wet spring, yields are frequently low; but in years of normal or light rainfall, crop returns are said to compare favorably with those obtained on any other soil in the county. Owing to the general lack of a deep, firm subsoil, it is said to be difficult to maintain this soil in a productive condition.

The selling value of land of the Appling very coarse sandy loam varies from \$20 to \$80 an acre, depending largely on its location with reference to markets.

The organic-matter content of this soil is low. Organic matter and nitrogen, the latter one of the most expensive constituents of a commercial fertilizer, may be economically added to the soil by growing legumes in rotations and by plowing under winter cover crops.

In the following table are shown the results of mechanical analyses of samples of the soil and subsoil of the Appling very coarse sandy loam:

*Mechanical analyses of Appling very coarse sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
234505.....	Soil.....	16.0	17.6	6.6	16.6	10.4	24.7	8.1
234506.....	Subsoil.....	8.9	7.6	2.5	6.8	4.8	26.6	42.7

APPLING SANDY LOAM.

The Appling sandy loam consists of a light-gray loamy sand to sandy loam, 6 to 8 inches deep, passing through a light-yellow sandy loam to sandy clay into a mottled pale-yellow and red, friable, gritty silty clay at about 12 to 14 inches. The surface soil is uniformly light gray or white, but the subsoil color is variable, ranging from pale yellow along the colluvial-like lower slopes and in flat upland depressions, through the typical mottling of yellow and red, to pale or pinkish red on some of the small knolls and steeper slopes. Frequently the mottling gives way to large alternate blotches and strata of various shades of red and yellow. In the southern part of the principal development of the type and over a number of the small,

isolated areas the texture of the soil frequently approaches a fine sandy loam, while nearer the northern limit there are included small areas of comparatively coarse textured soil. Seams of white quartz come within the 3-foot section and outcrop in places, especially on small knolls and along ridges, forming gravelly areas too small to be accurately separated on the map. The underlying parent rocks consist of a white, soft, coarse-grained granite, with a considerable content of large flakes of muscovite mica and strata of coarse-grained mica schists. The lower subsoil in many places has a greasy feel owing to the admixture of partly decomposed material derived from the rock. In some places the partly weathered rock occurs within the 3-foot section, especially on low ridges and mounds, sharp crests, and steeper slopes, and occasionally the bedrock outcrops over small areas.

The greater part of this type occurs in the southeastern part of the county, in a belt lying between Buffalo Creek and the main line of the Southern Railroad and reaching from the State line northeast to the vicinity of Potts Creek. Another important area lies south and southwest of Waco. Smaller areas are mapped throughout the county

The larger areas of this type occupy broad interstream divides with gentle or rolling slopes to the drainage ways. The less extensive areas usually occupy small depressions along stream heads and reaching for a short distance down several of the smaller branches. The surface in general ranges from gently undulating to gently rolling, but is rolling in places as the larger streams are approached. Drainage is only fair to good. The light color of the soil and subsoil is probably due to a uniform lack of the iron compounds whose oxidation contributes the red color of the Cecil and Louisa soils, and is not the result of deficient drainage.

The Appling sandy loam is fairly extensive and the greater part of it is in cultivation. The uncultivated areas support a forest growth of pine, oak, hickory, walnut, wild cherry, and dogwood. Cotton, corn, oats, cowpeas, clovers, and grasses are the principal crops. Cotton yields an average of one-third to 1 bale per acre, depending largely upon the methods of cultivation and fertilization. The crop matures early and large-bolled varieties, principally the Cleveland Big Boll, are grown. Long-staple cotton is grown to a small extent. Corn yields from 10 to 40 bushels per acre. This is considered one of the best oat soils in the county, 10 to 50 bushels per acre ordinarily being obtained. Red and crimson clover, rye, and cowpeas are uniformly successful. Wheat is grown to a small extent, but the soil is not generally considered well adapted to this crop. The soil is adapted to the production of garden and truck crops, melons, Irish potatoes, and sweet potatoes. Sorghum, while

not so productive as on the heavier soils, gives a sirup of excellent quality. Spanish peanuts and bright-leaf tobacco are successfully grown in a small way. Cherries, plums, peaches, early apples, muscadine grapes, and small fruits produce well.

The soil is given the same fertilizer treatment as the Appling very coarse sandy loam. It is easily handled with light implements and work stock. In some places, especially in the more nearly level areas, the soil is slow in drying out to a workable condition in the early spring, and crops do not do well following a wet spring. In a normal to dry year yields are said to compare favorably with those obtained on any other soil in the county. Owing to lack of a deep, firm clay subsoil in most places, the effect of fertilization is apparently less lasting than on the Cecil soils.

The selling value of land of the Appling sandy loam ranges from \$20 to \$90 an acre, depending largely upon the location with reference to markets.

There is a general lack of organic matter in the Appling sandy loam. The more extensive growing of legumes and winter cover crops would be beneficial. The methods suggested for the improvement of the Cecil sandy clay loam can be applied equally well to this type.

#### LOUISA STONY LOAM.

The Louisa stony loam consists of a yellowish-brown to reddish-brown loam, 5 to 8 inches deep, underlain by a yellowish-red to bright-red, friable silty clay which characteristically has a greasy feel. Bedrock generally occurs within the 3-foot section, frequently within a few inches of the surface, and on the steepest slopes it outcrops over large areas. Large fragments of schist and angular quartz, and in places gneiss, lie thickly over the surface. Rounded boulders of conglomerate, composed mainly of sandstone pebbles cemented with iron, occur on the surface along the lower ridges and upper slopes of Kings Mountain in the vicinity of Dixon Gap.

The type occurs on a number of the highest points and steeper slopes of the Piedmont section of the county. The most important areas are mapped in the southwestern part along Broad River, including Jolly and Abes Mountains; in the southeastern part along the slopes and lower ridges of Kings Mountain and along some of the steeper stream slopes; and in the northern part along the slopes of Gilead Ridge near Ward Gap. The surface ranges from rolling to broken. The greater part of the land is rough.

This type is inextensive and of little agricultural importance. Only a very small proportion of it is in cultivation, mainly along the crests of divides and on the more gentle slopes. The unused land

is forested with shortleaf yellow and white pine, various oaks, hickory, dogwood, mountain laurel, and persimmon.

In the less rolling and least stony areas of deeper soil the type is suited to the same crops as the other types of the Louisa series and gives about the same yields. In general it is best adapted to forestry, pasturage, and orcharding.

#### LOUISA GRAVELLY LOAM.

The soil of the Louisa gravelly loam consists of a yellowish-brown to light reddish brown fine-textured loam, extending to a depth of 5 to 8 inches. Angular schist gravel and flat schist fragments, ranging from 2 to 8 inches in width, are abundant, and streaks and patches of quartz gravel occur in places over the surface. The schist fragments are occasionally platy, as in the vicinity of Kings Mountain. The subsoil consists of a yellowish-red to bright-red friable silty clay, with a characteristically greasy feel. The lower subsoil commonly contains an abundance of very small schist fragments, and bedrock is generally encountered within the 3-foot section. Red "galled" clay spots occasionally occur on the steeper cultivated slopes.

Along the northern foothills of Kings Mountain and centering between Dixon and Stepps Gaps the soil departs conspicuously from the typical. It is traversed by strata of dark-brown to black schists to such an extent as to have a dark-brown to black color in the surface soil. The subsoil ranges in color from steel gray through brown to red. This soil apparently does not differ from the typical Louisa gravelly loam in agricultural adaptation.

The Louisa gravelly loam occupies the higher ridge crests, high knolls, and a number of the rougher stream slopes. The areas are all comparatively small, the largest occurring along the southeastern county line, through the foothills of Kings Mountain, along lower First Broad and Broad Rivers in the southwestern part, and west, north, and northeast of Casar in the northwestern part. Small areas occur along the lower course of Whiteoak Creek. The surface ranges from rolling to strongly rolling or hilly. As the larger stream courses are approached many of the slopes become so rolling as to be unsuited to cultivation. Drainage is everywhere thorough.

The total area of this type is small. Probably not more than 40 per cent of it is in cultivation. The remainder supports a good growth of shortleaf pine, various oaks, hickory, dogwood, persimmon, cedar, and walnut. Cotton, corn, wheat, oats, cowpeas, clovers, and grasses are grown most extensively. Yields are practically the same as those obtained on the Louisa loam, and crops are fertilized in the same way as on that soil.

The numerous schist and quartz fragments over the surface of this type make tillage comparatively difficult, but they are said to prevent the soil from packing and to retard erosion to a considerable extent, thus making the cultivation of many of the steeper slopes possible. Crops on the areas in which the bedrock comes close to the surface are frequently injured by drought. The depth of plowing is generally shallow.

Land values on the Louisa gravelly loam range from \$10 to \$60 an acre, depending largely upon the location and topography.

More attention should be given to proper terracing and to building up the organic-matter content of this soil. The plowing under of coarse manures and winter cover crops, the growing of legumes in rotation with the clean-cultivated crops, and a general increase in the depth of plowing would increase the organic-matter and nitrogen content of this soil and make it more mellow and retentive of moisture. Many of the steeper slopes now in cultivation might more profitably be sown to grasses and used as pasture land.

#### LOUISA LOAM.

The surface soil of the Louisa loam consists of a yellowish-brown to reddish-brown loam, 5 to 8 inches deep. The immediate surface material in many places, especially the more nearly level areas, is grayish brown and rather sandy in texture. Small schist fragments are frequently more or less abundant over the surface, and the presence of these and of small mica flakes gives the soil a glistening appearance in many places. The subsoil consists of a light-red, friable, rather slick silty clay to clay. It has a slick, greasy feel in the lower part. Small schist fragments, remnants of the partially disintegrated bedrock, are occasionally encountered at depths of 16 to 20 inches, and the solid bedrock frequently comes within the 3-foot section. Small rather flat areas occur in places, especially on the crests of the wider ridges. Erosion here has not kept such close pace with disintegration, and the depth to bedrock ranges from 3 to 6 feet. Some small eroded areas of clay are included, mainly along the steeper slopes.

The Louisa loam occupies the crests of a number of the higher ridges and some of their more rolling slopes leading to the streams. The areas are all comparatively small. The surface ranges from gently rolling along the crests of the wider ridges to rolling or hilly as the larger streams are approached. Drainage is everywhere thorough.

The Louisa loam is a comparatively inextensive type. Probably 75 per cent of its area is cleared and in cultivation. The uncleared areas are forested with second-growth pine, various oaks, hickory, persimmon, and dogwood.

Cotton is the principal crop. A relatively large acreage is devoted to corn, wheat, oats, cowpeas, clover, and grasses. Cotton yields one-fourth to 1 bale per acre. Corn ordinarily yields 10 to 30 bushels per acre, but higher returns are occasionally obtained. Wheat yields 5 to 25 bushels and oats 15 to 40 bushels per acre. Cowpeas ordinarily give good yields of hay and seed. Clover does very well. The grasses native to this region thrive on this soil and furnish excellent grazing. Garden vegetables, truck crops, sorghum, Irish potatoes, sweet potatoes, muscadine grapes, small fruits, early apples, peaches, cherries, and pears give good yields.

Owing to its fine texture and low organic-matter content, this soil compacts badly after rains. In the areas where the bedrock comes close to the surface crops are liable to suffer from drought. The depth of plowing is generally shallow. Commercial fertilizers and barnyard manure are used in growing the principal crops. Ready-mixed fertilizer, commonly analyzing 8-2-2 or 8-3-3, and various combinations of acid phosphate, barnyard manure, and cottonseed meal are applied to cotton and corn land. Corn frequently receives a side application of nitrate of soda after the plants have come up. Wheat and oats are fertilized with about 200 pounds of acid phosphate per acre. A number of farmers apply 1 to 5 tons of ground limestone per acre in growing legumes.

Land values range from \$20 to \$100 an acre, depending largely upon the location with reference to markets.

This soil can be improved by the methods suggested for the Cecil clay loam.

#### LOUISA SILT LOAM.

Along the crests of ridges and on the more gentle slopes and uncultivated areas, the surface soil of the Louisa silt loam in the first 2 or 3 inches is a white, or light-gray floury silt loam, and the sub-surface layer to a total depth of 5 to 8 inches is a pale-yellow silt loam. On the more rolling cultivated slopes and knolls, from which the top soil has been eroded, the type consists of a yellow to light-brown silt loam to a depth of 5 to 6 inches. The subsoil is a reddish-yellow to light-red, friable silty clay, passing at about 12 inches into a light-red to red, compact but friable silty clay which has a characteristic greasy feel, especially in the lower part of the 3-foot section. The bedrock, largely fine-grained mica schist, is frequently encountered within the 3-foot section, especially along slight ridges and on knolls and the steeper slopes. Angular white quartz fragments are more or less abundant over the greater part of the type. Occasionally outcrops of the underlying schist occur, and give rise to small areas covered with platelike schist fragments of varying size.

This type occurs in the southeastern part of the county bordering Kings Mountain. The surface ranges from gently rolling to rolling. Drainage is good. The area of the type is comparatively small and not over 40 per cent of it is in cultivation. Cotton, corn, wheat, cowpeas, and grasses are the principal crops. Cotton yields one-fourth to three-fourths bale per acre, corn 15 to 30 bushels, wheat 5 to 20 bushels, and oats 10 to 30 bushels. Cowpeas produce good yields of seed and hay. Bermuda grass, lespedeza, and various other native grasses thrive. Garden vegetables, truck crops, sorghum, Irish potatoes, sweet potatoes, muscadine grapes, small fruits, early apples, peaches, cherries, and pears give good returns.

Owing to its low organic-matter content and fine texture, this soil packs badly after rains in cultivated fields. Its drought resistance is low, especially where bedrock comes within the 3-foot section. Some moderately deep fall plowing is done on this type. Commercial fertilizers analyzing 8-2-2 and 8-3-3 are used. Ordinarily, cotton receives 150 to 300 pounds and corn 150 to 250 pounds per acre. Corn is frequently given a side application of nitrate of soda after the plants are up. The small grains receive 150 to 250 pounds of acid phosphate per acre. Lime is used to some extent in the growing of legumes.

Best results are obtained by growing cowpeas or other legumes in rotation with the clean-cultivated crops and turning under winter cover crops and coarse barnyard manure to increase the organic-matter content of the soil and make it more mellow and less apt to pack. Deep fall plowing, on surfaces that do not wash, will expose the soil to the beneficial action of alternate freezing and thawing and allow it to store up a maximum supply of moisture.

#### TALLADEGA STONY LOAM.

The Talladega stony loam consists of 6 to 8 inches of light-brown to brown, micaceous loam, underlain by a yellowish-red to light-red or bright-red, friable, micaceous silty clay which has a slick, greasy feel. Frequently the partially disintegrated bedrock of chloritic and mica schist comes within the 3-foot section. Large schist and quartz fragments occur in abundance over the surface, and occasional fragments of diorite, granite, and gneiss are encountered. Large outcrops of schist and quartz occur, especially on the steeper slopes. Along the lower end of Kings Mountain platelike fragments of fine-grained mica schists, quartzose mica schists, and fine-grained gneiss occur abundantly over the surface and underlying the soil at shallow depths, and large rounded boulders of conglomerate, composed chiefly of sandstone pebbles cemented with iron, are scattered over the surface. This type is quite similar to the Louisa soils.

The Talladega stony loam occurs along the mountain chain in the northwestern part of the county known as Gilead Ridge; on Carpenters Knob, Buffalo Knob, in the northeastern part; on Old Sheep Knob, in the north-central part; and on Kings Mountain in the southeastern part. It occupies the wider crests and lower slopes of the higher mountains and the crests and entire slopes of the lower mountains. The topography ranges from rolling along the ridge crests and more gentle slopes to broken along the steeper slopes. Drainage is thorough. The covering of stones protects the soil from excessive erosion.

The type is comparatively inextensive and of little importance agriculturally. The greater part of it supports a growth of pine, various oaks, hickory, cottonwood, and mountain laurel. The surface in most places is too rough for farming, but some small fields are in cultivation along the wider crests of Gilead Ridge and on some of the lower slopes.

Corn is the principal crop. Yields of 15 to 30 bushels are produced. Small grains yield fairly well. Cowpeas give good returns of both seed and hay. Cotton does not mature in the average season. Irish potatoes and a number of garden vegetables are grown and give good yields. Apples are the principal fruit crop. Good yields of an excellent quality of fruit are obtained. Bermuda grass, lespedeza, and various other grasses thrive. The soil is naturally productive, and no commercial fertilizers are used.

The selling value of cleared areas of this soil ranges from \$5 to \$10 an acre. The value of the forested areas is determined largely by the accessibility and character of the tree growth.

#### CONGAREE FINE SANDY LOAM.

The Congaree fine sandy loam consists of a light-brown to reddish-brown very fine to fine sandy loam, 10 inches deep, passing through a light-brown loam or silt loam into a light-brown, friable silty clay at 16 to 20 inches. The lower subsoil is frequently mottled yellow and red, and sometimes yellow and gray. In places a greenish material ranging from loam to clay, probably representing a former surface soil deposited when the bottoms were lower lying and in a semi-swampy stage, is encountered in the lower subsoil. It outcrops along the stream channels. Small mica scales are more or less abundant throughout the 3-foot section.

The type is variable in texture. Areas of silt loam occur in numerous small, rather slight depressions in the wider bottoms. On some small ridges and knolls the texture is a sand or sandy loam.

The Congaree fine sandy loam occurs in comparatively narrow stream bottoms, principally in the eastern and southeastern parts

of the county. Its total area is small, but the greater part of the type is cleared and in cultivation. The uncleared areas are forested principally with oak, hickory, poplar, willow, sweet gum, beech, and maple. Various wild grasses flourish.

The surface of the Congaree fine sandy loam ranges from level to undulating. All the type is subject to overflow, but between periods of overflow the drainage is in general good. The principal crops grown are corn, wheat, oats, cowpeas, and grasses. In favorable years the yields are good. Corn yields 20 to 60 bushels per acre, oats 20 to 40 bushels, and wheat 15 to 30 bushels. Cowpeas give good yields of both hay and seed. Grasses, mainly Bermuda grass and lespedeza, occupy a considerable proportion of the type and afford good pasturage. Watermelons and cantaloupes yield well on the sandier areas. Sorghum gives good yields of hay or sirup.

Ordinarily this soil may be handled almost as early in the spring as the adjacent uplands, but it has been found necessary to ditch some of the wider bottoms. The soil is plowed comparatively deep, and generally worked to a good tilth. Very little commercial fertilizer is used.

The valuation of land of the Congaree fine sandy loam ranges from \$20 to \$100 an acre.

#### MEADOW (CONGAREE MATERIAL).

Meadow (Congaree material) includes bottom-land areas in which the soil varies widely in texture within short distances, ranging from sand to clay. This type is largely the result of sedimentation by the heavy floods of 1916. The long-continued rains and consequent floods which caused much damage over a large section of the southern Appalachian and Piedmont regions in the summer of 1916 were very destructive in Cleveland County. The greater part of the bottom-land crops was destroyed, and much of the soil was ruined. The normally rapid streams were swollen to unprecedented flood stages. In some places the soil mantle over the bedrock was entirely eroded away, while elsewhere alluvial material of varying texture was deposited to depths of 1 to 10 feet or more over the original surface soil.

Meadow (Congaree material) occurs along streams throughout practically all parts of the county, but in most cases the areas are too narrow to be shown on a map of the scale used in this survey. It is well drained between periods of overflow. The greater part of the type is cleared and was formerly in cultivation. The uncleared areas support a growth of willow, sweet gum, oak, hickory, poplar, beech, and maple, with various grasses. A small area has recently been plowed and sown to wheat and oats, but the greater part of the

type remains unreclaimed. Corn, wheat, oats, and grasses were the principal crops grown on this soil and as it is gradually brought back under cultivation it will undoubtedly be again devoted to these crops. Watermelons and cantaloupes produce fruit of excellent quality in the sandier areas. Bermuda grass and lespedeza are well suited to this soil, especially the heavier areas.

#### ROUGH STONY LAND.

Rough stony land includes uncultivated areas along the upper slopes and across the crests of a number of mountains in the northwestern part of the county, and on the upper slope and over the crest of the Pinnacle of Kings Mountain, in the southeastern part. The soil material occurs in pocketlike areas of varying size interspersed with outcrops of huge boulders of quartz, quartzite, schists, and occasionally granite. Numerous bare, perpendicular rock walls 50 to 200 feet high occur on the upper slopes. The soil mantle consists of light-brown, micaceous loam, 5 or 6 inches deep, underlain by a subsoil of yellowish-red to bright-red, friable silty clay, with a characteristic greasy feel. The underlying parent rock usually is encountered within the 3-foot section.

The Rough stony land is of small extent and of no agricultural importance. Its surface ranges from steeply rolling to broken and precipitous. The steeply rolling land is forested with a growth consisting principally of various oaks, hickory, and pine. The steeper areas consist of walls comparatively bare of vegetation except for occasional stunted oaks.

#### SUMMARY.

Cleveland County lies in the southwestern part of North Carolina. Its general topography is that of a broad plain of moderate elevation sloping gently southward. Occasional mountains and hills stand out prominently above the surrounding country.

The county is ramified by a widespread system of watercourses, and the drainage is in general thorough. The streams have cut deep, narrow drainage ways. Most of them are fed by springs and flow continuously. There are vast water-power resources in the county.

Cleveland County had a population in 1910 of 29,494. Over 89 per cent of the total population is classed as rural. Agriculture is the principal industry.

Railroad facilities are good in the southern half of the county. The development of the northern part has been retarded by a lack of railroads. There is a large mileage of graded sand-clay public roads throughout the county. Telephone service and rural mail delivery routes reach all the farming communities, and churches and

schools are maintained throughout the rural districts. Charlotte is the principal outside market for farm products.

The climate of Cleveland County is mild. The average annual rainfall is 53.11 inches. The precipitation is well distributed through the year. The average growing season is about 200 days in length.

The agriculture of Cleveland County is centered about the production of cotton as the principal cash crop. Corn, wheat, oats, cowpeas, clovers, and various hay and forage crops are grown for subsistence purposes. Truck, sorghum, soy beans, peanuts, bright-leaf tobacco, small fruits, early apples, cherries, and pears are the principal minor crops.

Farming methods are gradually being improved throughout the county. Within recent years considerable attention has been given to crop rotations. Commercial fertilizers are used extensively.

The census of 1910 reports a total of 4,032 farms in Cleveland County, of an average size of 65.2 acres.<sup>1</sup> Practically one-half the farm land is improved. The proportion of farms operated by owners and by tenants is about equal. There has been a marked increase in the price of farm lands within recent years. The present valuations range from \$5 to \$100 or more an acre.

Almost the entire area of Cleveland County is in the Piedmont Plateau province. The mountain range along the northern boundary and various outlying ridges within the county are in the Appalachian Mountain province.

The upland soils of the county are derived from the underlying rocks, including granites, gneiss, schist, and diorite. The Piedmont soils are classed in the Cecil, Iredell, Appling, and Louisa series; the Appalachian soils in the Talladega series; and the stream-bottom soils, composed of materials washed from the uplands, in the Congaree series.

The Cecil sandy clay loam is the most extensive soil in the county. It is well suited to the production of cotton, corn, wheat, oats, legumes, various hay and forage crops, vegetables, small fruits, and tree fruits. This type can be brought to a high state of productivity. In common with the other soils of the county, it is low in organic matter.

The Cecil clay loam represents the universally recognized "red land" of the county. Early-maturing varieties of cotton are best suited to this type. It is particularly well adapted to subsistence crops, such as corn, wheat, oats, cowpeas, and sorghum.

The Cecil fine sandy loam is well suited to all the crops common to this region. This soil in general is not as desirable as the heavier Cecil soils, but it is highly prized on account of ease of handling.

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<sup>1</sup> Each tenancy is counted as a "farm."

The Cecil stony loam is of small extent and of little agricultural importance. It is best suited for use as pasture and forest land.

The Iredell loam, or "blackjack-oak land," is characterized by the waxy, puttylike character of the subsoil. It is best suited to the small grains and grasses.

The Appling sandy loam is a fairly extensive soil, largely in cultivation. It is easily handled. All the common crops are grown on this type. It is not well suited to wheat, but is considered well adapted to oats and clover.

The Appling very coarse sandy loam differs from the sandy loam mainly in its coarser texture and gravel content. The greater part of this type is under cultivation to the general farm crops.

The Louisa loam is well adapted to cotton, corn, wheat, oats, legumes, and grasses. Crops on this soil are liable to injury from drought. It has a tendency to pack after heavy rains. The organic-matter content is low.

The Louisa silt loam is well suited to the common farm crops. This soil is especially apt to pack after hard rains, and crops are occasionally injured by drought.

The Louisa gravelly loam is very similar to the Louisa loam. The gravel content tends to prevent packing, but it makes cultivation more difficult.

The Louisa stony loam occurs on some of the higher hills and ridges and on the steeper stream slopes. It is best adapted to pasturage and forestry.

The Talladega stony loam is developed on the wider crests and lower slopes of the higher mountains and over the lower mountains. Very little of it is in cultivation, and it is unimportant agriculturally.

The Congaree fine sandy loam is an inextensive soil developed in the first bottoms of streams. It is well suited to the production of corn, small grains, and grasses.

Meadow (Congaree material) includes undifferentiated areas of alluvial soil occurring along streams. Little of this type is farmed at present.

Steep and broken areas of stony soil are mapped as Rough stony land. This type occurs on the steep upper slopes and narrow crests of the larger mountains. It supports only a sparse timber growth.

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