

Issued May 19, 1916.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE NORTH CAROLINA DEPARTMENT OF AGRICULTURE,
W. A. GRAHAM, COMMISSIONER; B. W. KILGORE, STATE CHEMIST AND
DIRECTOR EXPERIMENT STATION; C. B. WILLIAMS,
AGRONOMIST.

SOIL SURVEY OF LINCOLN COUNTY,
NORTH CAROLINA.

BY

R. T. AVON BURKE, OF THE U. S. DEPARTMENT OF AGRICULTURE,
AND L. L. BRINKLEY, OF THE NORTH CAROLINA
DEPARTMENT OF AGRICULTURE.

W. EDWARD HEARN, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1914.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., November 3, 1915.

SIR: During the field season of 1914 a soil survey was made of Lincoln County, North Carolina. This work was done in cooperation with the North Carolina Department of Agriculture, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1914, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Lincoln County sheet, North Carolina.

SOIL SURVEY OF LINCOLN COUNTY, NORTH CAROLINA.

By R. T. AVON BURKE, of the U. S. Department of Agriculture, and L. L. BRINKLEY, of the North Carolina Department of Agriculture.

DESCRIPTION OF THE AREA.

Lincoln County, North Carolina, lies in the south-central part of the western half of the State. It is bounded on the north by Catawba County, on the east by the Catawba River, which separates it from Mecklenburg County, on the south by Gaston County, and on the west by Cleveland County. Burke County touches the northwest corner.

In outline the county approaches a rectangle. The north and south boundaries are straight lines, but the east and west boundaries are slightly irregular. The greatest length of the county east and west is about 30 miles, and the average width about 10 miles, north and south. The county comprises an area of 305 square miles, or 195,200 acres.

Lincoln County lies in the Piedmont Plateau section of the State. The topography, which is destructional, is rolling to hilly, erosion and stream dissection having reached an advanced stage. The surface now presents a succession of ridges with deep intervening valleys. The tops or crests of the ridges are gently rolling. They represent remnants of the original table land and include some of the most valuable farm lands in the county. One of the largest and most extensive areas of gently rolling topography lies along the Cherryville road, passing Mount Vernon Church, Hulls Crossroads, and Flay, and extending to the Gaston County line. The same ridge extends east toward Lincolnton and is broken by only one or two stream courses. A second important ridge lies between Howards and Indian Creeks south of Henry, and another passes Pleasant Grove Church and Hoyles Store, extending as far west as the site of the old Smiths Store, with numerous important lateral ridges extending in all directions. There is much desirable land on the ridges east and west of the South Fork of the Catawba River in the north and central parts of the county, as well as on the crest of the divide north and south of Macedonia Church.

The tops of the ridges in general have an elevation above sea level ranging from 800 to 1,500 feet. The highest altitude is in the northwest corner of the county, and the lowest in the southeast. A few hills rise conspicuously above the surrounding country. The highest

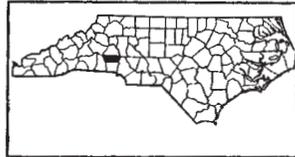


FIG. 1.—Sketch map showing location of the Lincoln County area, North Carolina.

is Buffalo Knob, in the northwestern corner, with an altitude of about 1,500 feet. This is an outlier of the Blue Ridge. Heldermands and Reese Mountains in the southeast part of the county have a lower elevation, but stand out in bold relief from the surrounding country.

The deepest valley in the county is that of the Catawba River, near the Gaston County line. Here the river lies only 650 feet above sea level, while its South Fork where it crosses the same line flows in a bed 100 feet higher.

The larger streams have worn their valleys so deep that their velocity has been reduced, and recurrent overflows have developed large areas of bottom lands. These are extensive along the South Fork of Catawba River, particularly in the central and northern parts of the county. This stream is swifter in the southern part of the county, and here little or no bottom land is found along it. Many of the large tracts of bottom land are not only subject to frequent overflows, but the streams are so winding and tortuous that the drainage is poorly established.

Lincoln County is well drained, and all its streams are perennial. The general drainage of the county is into the Catawba River. With the exception of the drainage west of the Cherryville road, which is into Buffalo Creek, all of the surface water in the western half of the county flows into the South Fork of Catawba River, for the most part through Howards and Indian Creeks. This fork also receives the water of Clark Creek and its tributaries, which drain the north-central part of the county. The extreme eastern part of the county is drained directly into the Catawba River, while the east-central part is tributary to Dutchmans Creek, which empties into the Catawba River in Gaston County.

The approaches to the watercourses vary considerably. The slopes along the larger streams are badly dissected and broken in places. The rougher slopes border the Catawba River. The most precipitous bluffs are in the southern part of the county along the South Fork of the Catawba River between Laboratory and the Gaston County line, where in places they consist of steep rock walls. The approaches to the smaller streams are more gradual and smooth, in general, although in places they are much gullied.

In many places the streams have sufficient fall to afford power for the operation of grist mills and gins. The greatest power developed is on the South Fork of Catawba River and along Indian Creek a short distance from Lincolnton, where there are six cotton mills in operation. Considerable power could be developed along streams in other places.

Lincoln County was formed from a part of Mecklenburg County, and previously was embraced in Anson County, which covered a large part of the State. The early settlers were Scotch-Irish, German, French, and English. The Scotch-Irish and Germans came from

Pennsylvania and Virginia. The French and English came from the eastern parts of the Carolinas.

The population of Lincoln County in 1910 is reported by the census as 17,132. The increase during the preceding decade was somewhat less than the average for the State. Of the present population, 83.6 per cent are of native parentage and 16.3 per cent are negro. The population is all classed as rural, the census reporting no incorporated place of 2,500 population, and averages 57.3 persons to the square mile.

Lincolnton, with about 2,500 inhabitants, is the county seat and largest town. It has been an important trading center from the early history of the county. Denver, Crouse, and Iron Station follow in size in the order given.

The county is traversed by two railroad lines, the Seaboard Air Line and the Carolina & Northwestern. The former enters the county near Crouse and extends northeastward to Lincolnton, where it turns to the southeast, passing Iron Station. The Carolina & Northwestern runs north and south through the middle of the county along the South Fork of Catawba River, passing through Lincolnton, Laboratory, Southside, and Longshoals.

A system of improved public roads radiating in all directions from Lincolnton has been begun. One highway has been extended 17 miles from the county seat.

Local and long-distance telephone lines extend to all parts of the county and rural free delivery routes reach all sections. Churches and schools are conveniently located throughout the county.

The local markets for the products of the county are Lincolnton and the mill towns. The cotton mills consume a large part of the cotton. Charlotte, located only a few miles to the southeast of the county, is another market for cotton and other farm products.

CLIMATE.

The climate of Lincoln County is healthful, and lacking in extreme temperatures of either summer or winter. For the winter months of December, January, and February the monthly mean temperature is 42.5° F., according to the records at Charlotte, in Mecklenburg County, the Weather Bureau station nearest Lincoln County. The winters are usually characterized by recurrent cold snaps, rarely lasting more than two to four days. Snow is common in the winter, but it seldom remains on the ground for more than a few days. The most disagreeable feature of the winter season is the prolonged misty rains, generally accompanied by northeast, east, or southeast winds. The summer is usually pleasant. Occasionally the weather is hot or oppressive, but the nights are generally pleasant. The monthly mean temperature for June, July, and August at Charlotte is about 77° F. The highest temperature

recorded is 102°, reached in both June and July, and the lowest temperature recorded in summer at Charlotte is 45° F., in June. The seasonal means for spring and fall are nearly alike, about 60° F. There is undoubtedly some local difference in the temperature in the valleys and in the uplands.

The precipitation is ample for the growing of crops and is well distributed throughout the year. The annual mean at Charlotte is 48.77 inches. Even the driest year had 34.78 inches, and 68.44 inches fell in the wettest year.

Lincoln County has a growing season of about 210 days, which is sufficient for the production of a wide range of crops. The average date of the first killing frost in the fall is November 4, and of the last in the spring March 29. The date of the earliest frost recorded in the fall at Charlotte is October 8, and of the latest in spring April 26.

Lincoln County has an abundance of good water. Good springs are found in all parts of the county, while excellent water is also obtained from wells.

The following table, compiled from the records of the Weather Bureau station at Charlotte, represents the climatic conditions of Lincoln County:

Normal monthly, seasonal, and annual temperature and precipitation at Charlotte, Mecklenburg County.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	42.9	76	-5	3.84	1.87	5.72
January.....	40.4	77	-1	4.06	2.26	7.60
February.....	44.1	79	1	4.37	5.40	6.43
Winter.....	42.5			12.27	9.53	19.75
March.....	50.8	91	14	4.41	1.55	9.19
April.....	59.2	94	26	3.53	1.90	5.40
May.....	68.4	97	37	3.89	1.68	4.84
Spring.....	59.5			11.83	5.13	19.43
June.....	75.5	102	45	4.32	3.35	9.47
July.....	78.7	102	55	5.16	6.38	7.90
August.....	76.6	100	53	5.89	1.05	2.08
Summer.....	76.9			15.37	10.78	19.45
September.....	70.7	99	38	3.28	4.69	3.57
October.....	61.1	92	30	3.13	0.98	1.51
November.....	50.4	80	18	2.89	3.67	4.73
Fall.....	60.7			9.30	9.34	9.81
Year.....	59.9	102	-5	48.77	34.78	68.44

AGRICULTURE.

Lincoln County, in common with central North Carolina, was first settled in Colonial days. The early immigrants were mainly Scotch-Irish and Germans from New York, New Jersey, Pennsylvania, South Carolina, and some from other sections of North Carolina. The abundant grazing favored the live-stock industries, and trading in cattle and sheep, as well as in tallow, hides, and dairy products, was carried on with eastern cities. The crops grown by the pioneers were the small grains, corn, flax, tobacco, and indigo. Most of the wheat was ground at local mills by water power. The surplus flour was hauled largely to Charleston and Columbia. Grain production was comparatively extensive. Distilleries were numerous and consumed the excess of corn, small grains, and fruits.

Lincoln County ranked well among the western North Carolina counties in its agricultural development long before the Civil War. By 1850 more than one-fourth of the farm land was improved. By far the leading crop at this period was corn, with wheat, rye, and oats following. Irish potatoes, sweet potatoes, and flax were other important crops. Cotton, which had been introduced before the nineteenth century, by 1850 reached a production of 506 bales. The animal industries were well developed at this time. Dairying was important. The Civil War caused a setback in agricultural development, but since the period of reconstruction progress has been rapid. By 1890 half the farm land was improved. Corn was still the most important crop, occupying one-fourth the total improved land. Wheat was second, surpassing even cotton in acreage. Cotton was a staple money crop in 1890. It occupied almost one-sixth of the improved land. The production was 3,584 bales. Other crops were oats, hay, sorghum, and tobacco. Live stock was kept in less numbers in 1890 than in 1850, but the census indicates a marked increase in the quantity of dairy products.

The present agriculture of Lincoln County consists in the production of corn, cotton, wheat, oats, hay, and clover. Sweet potatoes, Irish potatoes, sorghum, and cowpeas, as well as garden truck and fruit, are grown on practically every farm, mainly for home use.

Corn is the most widely grown crop in Lincoln County. According to the census, it occupied 23,059 acres in 1909. It is probable that the acreage will be greatly increased, as much of the bottom land, now too wet, is being ditched and drained by the county. Corn is grown on nearly all the soils, with the exception of those lands which are wet and poorly drained the greater part of the year. The yields range from 15 to 80 bushels to the acre, depending upon the extent of fertilization and cultivation. The best yields are obtained on the heavier soils of the uplands and the silt loams of the bottoms.

The leaves and tops of much of the corn are removed and the stalks left in the field to mature the ears. Some of the farmers use corn harvesters and a part of the crop which is cut and shocked is later shredded.

Cotton is the second crop of the county in acreage and the leading money crop. The census report for the year 1909 gives the acreage of cotton as 16,641, which is somewhat less than one-fifth the area of improved farm land. The production was 6,446 bales.

Cotton is grown on all the well-drained soils, except where the topography is rough and the land stony. On many fields it is grown year after year to the exclusion of other crops. The yields in general range from one-third to 1 bale an acre. There is considerable difference in the relative yields on the various types of soil.

The third most extensively grown crop is wheat, which, according to the census, occupied an area of 7,922 acres in 1909. This cereal shows a decrease in acreage from its maximum in the year 1899, when it occupied 16,363 acres, or 2,000 acres more than cotton. The Hessian fly was partly responsible for the lower production of wheat, but the prevailing high prices of flour and wheat tend to encourage the extension of the wheat acreage, and more is being sowed annually. Wheat is sowed in the fall, being drilled in either on corn land or on peavine stubble.

The acreage in oats is given by the census for 1909 as 3,418 acres. This is less than half the acreage in wheat. Rye is grown on a small acreage. It is either used for winter pasturage, cut green for hay, or turned under as a soil renovating crop. It is a hardy crop and does well even on the poorest soils.

The production of winter grains is resorted to for the maintenance of productiveness. Such cover crops not only afford protection to slopes during the heavy rains of winter and early spring, but utilize plant food that would otherwise be lost by soil leaching or seepage, and further increase the organic-matter content of the soils, which is so essential to maximum production.

The census of 1900 reports 4,114 tons of hay of all kinds cut in the county. Of the 4,375 acres cut considerably more than half was in grains cut green, largely oats. The cultivated hay crops consist of timothy, redtop, red clover, and Johnson grass, and in addition a considerable acreage of cowpeas and sorghum is cut for hay. Timothy and red clover are usually sowed with the grains, particularly oats. Timothy is largely restricted to the upland soils, while redtop is mostly grown on the bottom lands. When red clover is grown alone it is generally sowed in a nurse crop of wheat. Johnson grass is considered by many farmers a pest, but when cut at the proper stage it makes an excellent hay. At present it is largely confined to the bottom lands. It makes a vigorous growth.

Cowpeas are sowed extensively. The vines in most cases are cut for hay, and yields range from 1 to 2 tons an acre. Where grown for hay cowpeas are usually sowed broadcast, but when cultivated for the seed they are usually planted in drills. As a soil-improving crop they are sowed between the corn rows at the last cultivation or planted alone in small patches. For this purpose they are grazed down by live stock and the stubble plowed under, or the crop is plowed under while green.

The pastures in general are rather thin, but occasionally after the hay crops of timothy and clover, redtop, and clover are removed the clover and grass lives for 2 or 3 years. Some of the farmers have a small patch of Bermuda grass, which is utilized for summer pasturage, and a smaller number grow a patch of bur clover for winter grazing.

The chief wild grasses used for feed are water grass, crab grass, and broom sedge. Water grass is restricted to wet and poorly drained bottom lands, while the other two grasses occur as volunteer growths in abandoned fields.

The census of 1910 reports the acreage in sorghum as 309 acres and the yield as 1,082 tons of cane. In 1909, 15,880 gallons of sirup were made. When grown for forage sorghum is usually sowed broadcast, but when grown for sirup it is planted in drills. This crop yields most heavily on bottom lands and on slightly depressed areas in the uplands. The best flavored and brightest colored sirup, however, is usually obtained on the well-drained uplands, and particularly on the sandy loam soils.

The miscellaneous crops of Lincoln County include vegetables, of which the most important are Irish and sweet potatoes and peas, peanuts, tobacco, orchard and small fruits, and nuts. None of these crops are grown on any considerable acreage. Irish potatoes in 1909 occupied 121 acres, which produced 10,394 bushels, and sweet potatoes were grown on 405 acres, with a production of 47,637 bushels. Potatoes are merely grown to supply near-by markets, or with other truck crops to meet home needs. Tobacco has never been a staple crop in Lincoln County.

The orchards are generally small and of little commercial importance. The 1910 census enumerates 139,917 fruit trees. Most of the farms have a few fruit trees or grape vines. Of apples the principal varieties are Early Harvest, Red June, Magnum Bonum, Kinnard, Limbertwig, and the horse apple; of pears the Le Conte, Kieffer, and Seckel lead; the Slappy, Elberta, Sneed, Carman, and Reeves Favorite are the chief varieties of peaches; and the grapes grown include the Scuppernong, Moore, Concord, Niagara, and Lutie. Where attention has been given to the orchards the success has been pronounced, and it is probable that an extension of orcharding would

be profitable, particularly on the high upland soils not at present suitable for the economic production of cultivated crops. The total value of all orchard products, including fruits and nuts, was \$28,995 in 1909.

The live-stock industries are not well developed in Lincoln County, although the county has such advantages as mild climate, good water resources, and an abundance of wild and cultivated grass and forage feeds. The 1910 census reports a total income in 1909 from all live-stock sources, including cattle, horses, mules, hogs, sheep, poultry, and bees, of \$65,642, which is less than the income from vegetable crops. This amount does not include the value of products consumed on the farms. Dairying and cattle raising are the leading types of animal industries. Of the 5,914 cattle, 3,383 are dairy cows. In 1909, 412,278 pounds of butter were made on farms, of which 124,283 pounds were sold. Most of the cattle are native stock, although a few farmers are endeavoring to build up herds of beef and dairy cattle of better blood. The value of animals sold and slaughtered in 1909 was \$144,936. Hogs rank next to cattle in number, and are raised to some extent on almost every farm. Sheep are no longer important.

Only a small part of the fields of Lincoln County are plowed in the fall, and this practice is largely restricted to the grain lands. The greater part of the cultivated land is used for cotton and corn, and plowing is usually done shortly before the planting of crops. As a result the soils are generally bare and unprotected during the winter and early spring, and exposure to the heavy rains of these seasons causes excessive wash and erosion. Plowing thoroughly and deeply in the fall tends to prevent this, restricts the need of terraces, conserves soil moisture, and allows frost and aeration to penetrate deeper.

Where the lands are broken flat the plowing is generally too shallow, rarely being over 5 inches. The depth should be increased to about 10 inches. This can be accomplished in one plowing if a disk plow is used and the disks so set as not to turn up subsoil. When, however, the turn plow is used the depth should be increased gradually from year to year, as the turning up of much of the unweathered subsoil is detrimental. Where no cover crop is planted after fall plowing occasional harrowing lessens evaporation. Deep plowing on the lighter soils, particularly the deeper sandy loams, is not so essential unless it is done to turn under grass sod, grain stubble, or coarse forage. The incorporation of such organic matter constitutes the chief means of improving these soils, which are generally deficient in humus.

The growing scarcity of labor in Lincoln County makes the use of labor-saving machinery and tools almost imperative, and much of the land lies so as to make their use economical. The number of walk-

ing and riding cultivators, deep-tillage machines, sulky plows, mowing machines, harvesters, binders, feed cutters, weeders, drills, harrows, huskers and shredders, as well as thrashing outfits, is increasing. Tractor engines are occasionally used to draw gang plows, harrows, and sometimes rollers in preparing land for grain crops.

Much of the land of the county is light and good tilth can easily be maintained, but on the heavier types of soil heavier machinery and stronger work stock are required.

The use of fertilizer has generally been found profitable on the well-drained soils. The naturally low organic-matter content of most of the soils is readily increased by plowing under green manuring crops, and with a good content of organic matter in the soil the efficacy of commercial or other fertilizers is greatly increased. The total expenditure for fertilizer in 1909 is reported by the census as \$61,012. This is about three times the amount expended in 1879 and twice the outlay in 1889. The mixtures used vary considerably in the percentage of available phosphoric acid, potash, and nitrogen. The formulas most commonly used are 8-2-2¹ and 8-3-3 mixtures. In addition to these, use is made of a relatively small quantity of kainit, treated phosphoric rock, and nitrate of soda, and also less cottonseed meal and barnyard manure. These are often mixed on the farm to meet the special needs of crops. When commercial mixtures are used for cotton or corn they are commonly put in with the seed, though some of the farmers place the fertilizer in the soil a week or 10 days prior to planting, and others aim to feed the crop at different stages of its growth. The acreage application for corn on the uplands ranges from 100 to 500 pounds. It is generally believed that manure gives the best results, but the supply of this is in most cases inadequate. Corn grown on the bottom lands is rarely fertilized. The application for cotton ranges from 200 to 800 pounds to the acre.

There is no systematic crop rotation in general use throughout the county. Cotton or corn is usually produced year after year on the same fields. Cotton is reported to have been grown continuously on certain fields for a period of 20 years and on one field it is reported to have been grown 40 years. As a rule, when the yields are seriously reduced by continuous production, recourse is had to such grain crops as wheat or oats, with which are sowed red-top and red clover on the moist uplands or bottom lands, and timothy and clover on well-drained uplands. Most of the farmers sow the grass seed with the oats, and when wheat is sowed red clover is sowed in the wheat the following spring. The grain is harvested and the next and the following year a crop of hay is removed. After this the field is pastured for an indefinite period, when it is put

¹ Figures represent percentages of phosphoric acid, nitrogen, and potash, respectively.

back into cotton or corn. Some of the farmers alternate corn with cotton, changing from the one to the other every year. Others produce two or three crops of cotton and then put the land in corn about an equal number of times, when it is put in grain, followed by hay, and then pastured for an indefinite period.

The fact that corn and cotton can be grown on nearly all soils with more or less success has caused a general tendency to disregard the characteristics of the different soil types and their particular relation to crops and plant varieties. Some farmers, however, recognize differences in the various soils and their relative adaptation to certain crops.

The labor supply in general is rather inadequate. Most of the laborers employed are white, especially away from the larger towns. When employed by the month the pay is about \$1 a day or 80 cents a day with board. The rate for day labor is about \$1.50 per day. Cotton pickers at the beginning of the season get 50 to 60 cents a hundred pounds, and in the latter part of the season 75 cents or even \$1.

The tenant system is well developed in Lincoln County. According to the census of 1910, 41.5 per cent of the number of farms were operated by tenants, though they occupied less than one-third of the entire farm land. The rental is usually on a share basis. When the landlord supplies all work stock, tools, and other equipment, he receives one-half of all the products. If the tenant furnishes his own work stock and equipment, the farm owner receives only one-third of the crop. In both instances the owner contributes to the cost of fertilizer in proportion to the share of crops that he receives. In some instances the lease is based on a cash consideration, which varies from \$3 to \$5 an acre.

The number of farms in Lincoln County has increased steadily. The census of 1910 reports 2,244 farms, of an average size of 77 acres, of which about 40 are improved. Most of the holdings are of moderate size, and about three-fourths of them are between 20 and 175 acres in size. The census figures show a more intensive agriculture in Lincoln County than the average for the State. The census reports 90.5 per cent of the land area in farms, and much of the remainder is more or less rough and broken land, though there are still large tracts suitable for farming that are not at present utilized. Land values have increased considerably in the last few years. To make the farms pay profitable interest on their value it has become necessary for the farmers to utilize more efficient methods, and there is a tendency to break away from the exclusive production of one or two staple products. With the more general adoption of diversified farming many crops now of only minor importance will gradually be worked into the crop rotations.

Land values in Lincoln County range from \$15 to \$100 an acre, depending upon the location and improvements.

SOILS.

Lincoln County lies wholly within the Piedmont Plateau region. All the upland soils are residual in origin, having been derived in situ from the weathering of the various rock formations. The rocks underlying the greater part of the county are closely related, but show some marked differences, and the soil materials resulting from their disintegration and decay are even more varied in character. The coarser textured rocks have contributed largely to the formation of the coarser textured soil types, while the fine-grained rocks give the heavier types, such as the clay and clay loams. Further differences than those due to parent material have been brought about in the texture of the soil through erosion, which has influenced the depth of the surficial sandy material. This has been removed by erosion along some of the slopes and the underlying red clay exposed. In other places the finer particles have been transported by water, and the surface material has become more sandy and lighter in texture.

The dominant rocks from which the soils have been derived are granites, gneisses, schists, and imperfectly crystalline slates and diorites. The granites and gneisses have by far the widest distribution and underlie perhaps 80 per cent of the area of the county. These rocks are composed mainly of quartz and feldspar, with some mica and hornblende. They have weathered usually to a depth of several feet, and only where erosion has kept close pace with disintegration do the unweathered rocks lie near the surface. These formations give rise to the Cecil and Appling series of soils.

Northwest and east of Lincolnton, southwest and south of Kidville, and in the northwest corner of the county there occur mica schists and imperfectly crystalline slates, the latter having a pearly, lustrous appearance and showing, on decomposition, shades of gray, blue, pink, and purple. These rocks have weathered to form the Louisa soils. This series is characterized by its content of minute mica scales and by the greasy feel of the subsoils.

Scattered over the southwestern part of the county are small areas of diorite, a drab-colored, hard, heavy rock. From this has been derived the Iredell series. Greenish-yellow, partially decayed bedrock is usually encountered within 3 feet of the surface, and the accumulation of soil material over the bedrock is nowhere deep. This is probably due to the impervious character of the subsoil, which does not allow free movement of air or water, and thus tends to prevent soil formation.

Veins of quartz penetrate all the formations, particularly the granites and gneisses. In places quartz rock is distributed over the surface in sufficient abundance to render the soils stony in character. Schist fragments also appear on the surface in places, especially in the Talladega stony loam areas shown by symbol in the Louisa clay loam type.

In addition to the residual upland types, there are strips of alluvial soil along the streams. This material has been washed from the Piedmont Plateau and deposited by the streams. The first-bottom soil is classed in the Congaree series.

In subsequent pages the recognized soils are described in detail. On the map accompanying this report the distribution of the various soil types is shown.

The following table gives the name and the actual and relative extent of each of the soil types mapped in Lincoln County :

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Cecil clay loam.....	77,056	} 42.8	Cecil clay.....	8,128	4.2
Hilly phase.....	6,400		Appling sandy loam.....	5,120	2.6
Cecil fine sandy loam.....	25,152	12.9	Louisa clay loam.....	1,920	1.0
Louisa gravelly loam.....	24,064	12.3	Louisa clay.....	1,408	.7
Cecil sandy loam.....	22,912	11.7	Iredell clay loam.....	1,024	.5
Congaree silt loam.....	13,696	7.0			
Cecil gravelly loam.....	8,320	4.3	Total.....	195,200

CECIL SERIES.

The Cecil series is characterized by its red-clay subsoils. The surface soils range from gray to red, the lighter colors being restricted to the sandy members and the red colors to the heavier types. The subsoils are easily recognized by their content of sharp quartz sand and the frequent occurrence of veins of quartz. The soils are residual in origin and are derived principally from granites ranging from fine grained to coarse or porphyritic, together with some gneiss, and are locally modified by schist or diorite. The weathering has proceeded to such an advanced degree that rock outcrops are rare. The series is represented in this county by the gravelly loam, sandy loam, fine sandy loam, clay loam, and clay types.

CECIL GRAVELLY LOAM.

The surface soil of the Cecil gravelly loam consists of a gray, reddish-yellow, or light-brown loam or fine sandy loam carrying from 20 to 50 per cent of fine, angular quartz gravel, together with some coarse sand. The subsoil begins at 6 to 12 inches from the surface

and is a stiff red clay containing some gravel and sharp, angular sand, in addition to small flakes of mica. The coarser particles render the type friable and crumbly.

The Cecil gravelly loam is distributed in a broad belt extending from the county line south of Crouse to Lincolnton and beyond, interspersed with scattered areas of Appling sandy loam and gravelly loam and Congaree silt loam.

This type occupies topographic positions ranging from stream slopes to broad, gently rolling ridge crests. It is generally well drained. In places the drainage is excessive.

Much of the Cecil gravelly loam is under cultivation, although large tracts are still covered with a mixed growth of white, red, and post oak, and hickory, with occasional pines. In places pine predominates.

This soil is used for the general farm crops—cotton, corn, wheat, oats, and hay—supplemented by garden truck and fruit for home use. Cotton gives an acreage yield of one-third to three-fourths bale; corn, 15 to 40 bushels; wheat, 10 to 20 bushels; oats, 20 to 40 bushels; and cowpea hay, three-fourths to 1 ton. Certain varieties of apples, peaches, and plums can be successfully grown, and the fruit has good color and quality. Vegetables do well.

This soil is easy to work, notwithstanding its gravel content. It warms up early in the spring, and crops mature early.

The type is generally deficient in organic matter. This can be incorporated by applying manure, by growing legumes, or by plowing under green manuring crops or the stubble after cutting for hay. Deep plowing is not usually practiced.

The Cecil gravelly loam can be made highly productive for the general farm crops. The land is valued at \$30 to \$75 an acre, depending upon the location and improvements.

CECIL SANDY LOAM.

In its typical development the surface soil of the Cecil sandy loam is prevailingly a gray loamy sand or light sandy loam, grading at about 6 inches into a reddish-yellow sandy loam which continues to a depth of 8 to 15 inches. The subsoil is a red, stiff clay to a depth of several feet. Usually it is characterized by a noticeable quantity of angular quartz sand intimately mixed with the clay, and seams or veins of quartz traverse the substratum.

In places over the surface and throughout the soil there are scattered quartz fragments, which in spots too small to map have accumulated in sufficient quantity to make the soil a stony sandy loam. As

the type approaches the Cecil clay loam it changes to a brown or light-brown sandy loam or heavy sandy loam, while throughout its distribution it includes many small, unmapped patches of Cecil clay or Cecil clay loam, where the surface material has been wholly or partially removed by erosion. In the area along the ridge east of Indian Creek, beginning about $1\frac{1}{4}$ miles west of the place formerly occupied by Smiths Store, the surface soil is but slightly coarser than that of the Cecil fine sandy loam. The soil is coarser than typical in a small area on the west county line and west of the railroad toward the county line about 2 miles south of Iron Station, where there are also spots of Cecil gravelly loam.

The Cecil sandy loam is developed principally in the northwestern and eastern parts of the county, in scattered and irregular areas, none of which are large. It has a level to gently rolling surface, which becomes more rolling and broken as the watercourses are approached. It is well drained.

Most of the Cecil sandy loam is under cultivation, although in places it supports a cover of white, red, and post oak, hickory, and, less commonly, pine and cedar. On the abandoned fields pine and scrub oak form the most conspicuous growth. The type is used for cotton and corn, supplemented by occasional crops of wheat, rye, mixed hay, and cowpeas, as well as garden truck and fruit. The yields of cotton range from one-third to two-thirds bale an acre. Corn yields 15 to 30 bushels, wheat 5 to 15, oats 10 to 30, and rye 15 to 20 bushels an acre. Mixed hay (timothy and clover) averages about 1 ton and cowpea hay 1 ton to 2 tons to the acre. All kinds of garden truck and fruit do well.

The general farm crops do best where the surface soil is shallow and the lowest yields are usually produced where the surface material is deepest, although good results are possible on both extremes under the most efficient methods of cultivation.

The Cecil sandy loam is an easy soil to work and crops mature early. Where the soil is deepest it is well suited to early truck crops and fruits, but present conditions do not justify the extensive development of trucking or orcharding. In general this type does not compare with the heavier soils for corn, grass, and small grain, although it can be made very productive. The need of most of the land is a greater supply of organic matter. This can be incorporated readily in the form of stable manure, or recourse may be had to green manuring crops or to the more frequent growing of winter cover crops and summer forage.

Land of this type is valued at \$20 to \$80 an acre, depending upon the location and improvements.

CECIL FINE SANDY LOAM.

The surface soil of the Cecil fine sandy loam is a gray to brown fine sandy loam, passing at about 3 to 6 inches into reddish-yellow loam or fine sandy loam. The typical subsoil, beginning at any level between 7 and 15 inches, consists of a pale-red to deep-red, stiff clay, which usually extends to a depth of several feet, although locally bedrock comes near the surface. Bordering the Louisa type the subsoil is somewhat micaceous, and adjoining the Appling soil it is frequently a yellowish-red clay. Such variations are noticeable near Flay on the Cherryville road.

The Cecil fine sandy loam includes patches of clay and clay loam where there has been excessive surface wash. Quartz fragments are scattered over the type in places, but seldom in sufficient quantities to interfere with cultivation. At the base of some of the slopes adjoining the alluvial lands are spots which have a gray to whitish surface soil, with a whitish or mottled yellow and white clay subsoil. This development is conspicuous, but in every instance it appears in areas too small to be mapped.

The Cecil fine sandy loam is an extensive type. Its principal development is in the southwestern part of the county, where it occurs in broad, continuous areas, and to the east and southeast of Lincolnton.

The Cecil fine sandy loam embraces broad, gently rolling ridges, and broken and rolling areas bordering streams. The topography favors good surface drainage, and all areas of the type are well to excessively drained. Erosion is active on the steeper slopes and terracing has been necessary in places to check the soil wash.

While a large part of this type is under cultivation, good-sized tracts still support the original forest growth of oak, hickory, dogwood, and cedar. This type is not considered so strong a soil as the Cecil clay or clay loam, but it produces good yields of the general crops of the county. The yields of cotton range from one-third to two-thirds bale per acre. Corn yields 15 to 40 bushels, wheat 8 to 20 bushels, and oats 15 to 40 bushels, while sweet potatoes, cowpeas, and garden crops do well. Commercial fertilizers are used on all these crops.

This soil, like its associated types, is deficient in organic matter. This can be supplied by the use of barnyard manure or by the growing of cowpeas, clover, and soy beans, to be turned under. Liberal applications of lime are beneficial on this soil, especially after organic matter has been supplied. Where the clay lies near the surface plowing should be deeper and the land pulverized thoroughly before planting is done. Deeper plowing and the addition of organic

matter cause the soil to absorb more of the rain water and to a large extent check erosion.

Land of the typical Cecil fine sandy loam sells at \$15 to \$80 an acre, depending upon location and improvements.

CECIL STONY LOAM.

The areas in Cecil fine sandy loam color marked on the map with stone symbols represent Cecil stony loam. This is a gray to reddish-yellow loam or very fine sandy loam, having a depth of 5 to 8 inches. It is underlain by a red clay subsoil. Quartz fragments of varying size are in abundance on the surface and are in places embedded in the soil to such an extent as to make it difficult to penetrate with a soil auger. Except for the presence of these stones, this type is not essentially different from the Cecil fine sandy loam.

Only small bodies of the stony loam are encountered, and these are confined largely to the northwest corner of the county and the central part east of Lincolnton. This type is developed on the knolls and slopes and the highest hills, or so-called mountains, and has good natural surface drainage. Very little of this soil is under cultivation. It supports a growth of scrub oak, oak, hickory, and pine. The stones on the surface render difficult the use of improved machinery. In a few fields, however, the stones have been removed, and here the soil is well suited to the general crops. It can probably be most profitably used for forestry, orcharding, or pasturage.

CECIL CLAY LOAM.

The surface soil of the Cecil clay loam is dominantly a brown or red clay loam or loam ranging in depth from about 5 to 8 inches. The subsoil is a red, stiff clay, moderately brittle when dry, but sticky and slightly plastic when wet. The type is known as "red land." In places the top few inches of soil is a gray or brown, heavy sandy loam. Spots of clay and sandy loam too small in extent and too intimately associated to be separated on the soil map are encountered throughout many areas of the Cecil clay loam. Quartz fragments are scattered over the surface, but rarely in sufficient abundance to interfere with cultivation. The surface soil in depressions and adjoining well-developed bottom-land areas is deeper and has a stronger chocolate color than typical. This phase is locally called "dead land" or "push land."

In general, the Cecil clay loam is an intermediate type, both in color and texture, between the Cecil clay on the one hand and the Cecil sandy loam or fine sandy loam on the other. It represents in places Cecil fine sandy loam or sandy loam with the surface soil wholly or partially removed by erosion, and in other places the same types

with such topographic position that there has not been carriage of the finer particles of surface material to lower levels.

The Cecil clay loam is the most extensive soil mapped. It occurs in all parts of the county. It is well developed on the uplands between Clark Creek and the South Fork of Catawba River, but more extensively between Howards Creek and the South Fork. A wide area occurs between Leonard Fork and Rockdam Creek.

The Cecil clay loam occupies topographic positions ranging from level to gently rolling ridge crests or divides to dissected and broken interstream country. Its general position, however, is along the slopes to the watercourses, which may be gentle, abrupt, or steep.

Drainage is well developed and in places excessive. More damage is done on this soil by wash than on any other in the county, with the exception of the Cecil clay. Some fields have been abandoned on account of wash. Where the surface soil is worked to depths of 8 or 10 inches and supplied with organic matter the effects of erosion are much lessened.

The forest growth on this type consists of white, red, and post oak, hickory, pine, and cedar. Pine is most common on rough land. Much of this type, where the topography is most favorable, is under cultivation. It is used principally for cotton, corn, wheat, oats, and mixed hay (timothy and red clover), in addition to garden truck and fruit for home use.

The yield of cotton ranges from one-third bale to $1\frac{1}{2}$ bales an acre. Corn yields 20 to 80 bushels, wheat 10 to 35, and oats 20 to 50 bushels. Hay usually cuts 1 ton to 2 tons an acre. Red clover alone makes one-half to 1 ton, and cowpeas for hay yield 1 ton to $1\frac{1}{2}$ tons to the acre. Such garden truck as tomatoes, cabbage, lettuce, potatoes, onions, turnips, radishes, cauliflower, peas, and beans do well, but they do not mature so early on this type as on the lighter Cecil soils. Success has attended the growing of raspberries, blackberries, and currants. Of the tree fruits, the apple, peach, pear, plum, and cherry produce abundantly under favorable conditions. The fruits, however, are mainly grown for home use only.

The yields of cotton and corn are generally maintained by making larger applications of fertilizer from year to year. The common application is from 200 to 500 pounds of 8-2-2 or 8-3-3 mixture. Some farmers fertilize the crops at various stages in their growth, mixing the fertilizer themselves and varying the formula to meet special requirements of soils or crops.

No systematic crop rotation is in use on this type. Corn and cotton are grown successively year after year on the same fields. Some farmers alternate them every year or every second year, and others grow one crop for a number of years and then the other. When the yields decrease noticeably corn may be followed by wheat or oats,

in which are sowed timothy and clover. The year after the grain is cut the hay is harvested and the field pastured for a period of 1 year to 4 years. Cowpeas are often sowed in corn at the last cultivation or on oat or wheat sod after the grain is harvested. Timothy and clover are usually sowed in oats, but not infrequently clover is sowed alone in wheat in the spring.

The Cecil clay loam is recognized as one of the strongest soils in the county for corn, grass, and small grain. More general success has been attained with wheat on this type than on any other soil in the county.

The surface soil over much of this type is too shallow and compact for good results, and is lacking in organic content. The soil should be plowed to a depth of 6 to 12 inches. This depth should be reached gradually. When the ordinary turn plow is used not more than 1 inch each year should be added to the depth of tillage. The full depth can be reached at once when a disk plow is used and the disks so set as not to turn up subsoil. Where the depth is good droughts do not affect the yields so seriously as at present, and, further, destructive soil wash is largely lessened. Adding organic matter increases the water-holding capacity and lessens the tendency of the soil to become compact. The type is benefited by the application of lime at the rate of 1,000 to 2,000 pounds to the acre.

Land of the Cecil clay loam type ranges in value from \$15 to \$100 an acre, depending upon the improvements and location.

Cecil clay loam, hilly phase.—The hilly phase differs essentially from the typical Cecil clay loam in topography and incidentally in agricultural value. It is developed on hillsides and on steep and rather precipitous slopes flanking the stream-bottom lands. Although the surface in some areas is smooth, the phase is largely developed on badly washed and gullied hillsides. In places the type is broken by a succession of narrow, V-shaped gullies. This phase lies mainly in the eastern part of the county.

None of the land of this phase is at present under cultivation. A few areas were cultivated many years ago, but have been abandoned, mainly on account of excessive erosion. The narrow divides between the gullies have been reforested naturally. Over much of this phase the original growth, consisting principally of red, white, and post oak, hickory and poplar, remains. Many of the trees include merchantable timber and the value of this land depends largely upon the value of this timber.

This phase, owing to its prevailingly steep and broken surface, is unsuited to general farming. Most of the land could be seeded to grass and utilized for the grazing of sheep and cattle. Reclamation of the gullied areas can be effected in a large measure by filling the gullies with the branches of trees so as to arrest further washing. In

many places the narrow ridges and ravines can be leveled with the plow sufficiently to permit cultivation.

The incorporation of lime and manure in the raw soil improves it to such an extent that cowpeas, clover, and grasses succeed, and by turning these under the soil soon carries enough vegetable matter to make it much more tractable and productive of the general farm crops.

CECIL CLAY.

The Cecil clay as typically developed consists of a red, stiff clay which extends to a depth of several feet. Much of the type mapped, however, has a surface covering of 2 or 3 inches of red loam, clay loam, or heavy sandy loam. Weathering has developed a thick mantle of soil, so that the bedrock is rarely exposed and then only in a partially decomposed state. Veins of quartz, which have resisted weathering, appear in the soil mass in the same position they occupied in the original rock.

This type, like part of the Cecil clay loam, is locally known as "red land." These soils are closely associated, the clay representing in places the clay loam type with the surface soil partially or wholly removed by soil wash. The Cecil clay is developed throughout the entire distribution of the Cecil clay loam, but not always in areas large enough to map separately.

The type is well developed on the slopes along Border Creek as it approaches the Catawba River and in a similar position on the bench southeast of Triangle. Typical areas are also encountered on the slopes along Johnsons Creek near the Gaston County line. The greatest distribution is on the south slopes along Howards Creek.

The Cecil clay occupies low, rolling interstream areas, which are more broken and gullied nearer the watercourses. In many places the type has favorable surface features, with just sufficient slope to give good drainage and permit the unrestricted use of labor-saving machinery, but, in general, drainage is excessive and the soil covering is removed by surface wash as fast as it is formed. The Cecil clay is chiefly covered with a forest growth of oak, hickory, dogwood, pine, and cedar. The original timber cover was heavy, consisting largely of red, white, and post oak, and hickory. Pine in general is a secondary growth and usually takes possession of abandoned fields and clearings.

Only a small part of this type is under cultivation. It is used for the production of cotton, corn, wheat, oats, mixed hay (timothy and red clover), and cowpeas. Cotton yields one-third to 1 bale an acre; corn, 15 to 60 bushels; wheat, 15 to 30 bushels; oats, 20 to 60 bushels; hay, 1 to 2 tons; clover hay alone, one-half to 1 ton; and cowpea hay 1 to 1½ tons.

The Cecil clay is an excellent soil for the general farm crops, and particularly for grass, grain, and forage. Improvement made in it is lasting. The most serious problem on this type is the prevention of soil wash or erosion. This can be minimized by making terraces or sidehill ditches on the steeper slopes. Wash can in large measure be obviated by deep plowing, which also increases the moisture-holding capacity, in addition to its other benefits in the way of giving a greater feeding zone to crops, allowing heat and frost to penetrate deeper, and stimulating chemical and bacterial action. For the most efficient use of this land heavy draft stock and strong machinery are necessary.

Land of the Cecil clay type ranges in value from \$15 to \$100 an acre.

APPLING SERIES.

The Appling soils are characterized by gray surface soils and reddish-yellow, yellowish-red, or mottled yellow and red subsoils. They are derived from the weathering in place of the underlying coarse or fine-grained granite and gneiss, locally modified by mica schist. The series is represented in Lincoln County by the sandy loam type.

APPLING SANDY LOAM.

The surface soil of the Appling sandy loam is a gray or grayish-yellow loamy sand or light sandy loam to a depth of about 6 inches, where a more intense yellow or light-brown sandy loam is reached, which extends to 10 or 15 inches. The subsoil consists of a mottled yellowish-red or reddish-yellow sandy clay or friable clay, which usually reaches a depth of 3 feet or more. Over the surface there is a scattering of quartz, and less commonly quartzite fragments. These rarely occur in sufficient quantity seriously to interfere with cultivation or to cause the soil to be classed as stony. The stones are most abundant at the heads of draws and in depressions.

Near the confluence of Howards Creek and the South Fork of Catawba River, and in a few other localities, there are spots of Durham sandy loam which would have been mapped as a separate type if it had occurred in larger areas. The surface soil is a gray or yellowish-gray loamy sand, grading at 6 inches into a pale-yellow, light sandy loam, which continues to a depth of about 10 or 15 inches. The subsoil is a bright-yellow, friable clay or heavy sandy clay. This land is used for cotton, corn, oats, and sweet potatoes. It is especially suited to the production of bright tobacco.

The Appling sandy loam is found in all parts of the county. One of the largest and most typical areas occurs northeast of Lincolnton. It is slightly finer in texture than typical on the west slope of Helder-mans Mountain, and slightly coarser as it occurs in patches southwest of Lincolnton.

The Appling sandy loam occupies gently rolling to rolling country. Drainage is well established, but rarely excessive.

Much of this type is under cultivation, although there are many scattered patches of a mixed forest growth of oak, hickory, and pine. Cotton is the chief crop on this type, with corn second. Other crops are oats, rye, cowpeas, and sweet potatoes. Cotton yields one-third to three-fourths bale, corn 10 to 20 bushels, oats 10 to 25 bushels, rye 8 to 15 bushels, and sweet potatoes 100 to 300 bushels an acre. Cowpea hay averages 1 to 1½ tons to the acre. Garden truck and fruit do well.

The Appling sandy loam in general is easy to work. Crops mature early and the soil is well suited to the production of early truck and fruit, though other factors at present do not warrant the extensive development of trucking and orcharding. The type responds readily to improvement and can be brought to a high state of productiveness. The soil is deficient in organic matter. This can be supplied by restricting the growing of cotton and by cultivating a wider range of crops, including especially the legumes.

Land of the Appling sandy loam ranges in value from \$15 to \$60 an acre.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Appling sandy loam :

Mechanical analyses of Appling sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
233323.....	Soil.....	6.4	16.4	6.2	27.4	17.4	20.9	5.2
233324.....	Subsoil.....	3.4	10.0	3.8	17.4	9.6	18.2	37.5

APPLING GRAVELLY LOAM.

The areas in Appling sandy loam color indicated on the map with gravel symbol represent the Appling gravelly loam. The surface soil is a gray, slightly reddish or brownish loam or fine sandy loam extending to a depth of 6 to 15 inches. Commonly below 6 or 8 inches a salmon-red loam is encountered, extending to the subsoil. The subsoil is a reddish-yellow, brownish, or mottled red and yellow, moderately friable clay or coarse sandy clay. The clay may extend to a depth of 3 feet or it may grade into the disintegrated porphyritic granite or gneissoid rocks above this depth. Distributed over the surface and through the soil section is about 20 to 50 per cent of small, sharp, angular quartz gravel. In many places mica-schist intrusions have made the substratum micaceous and quartz veins or seams are common throughout the soil section.

Most of the Appling gravelly loam occurs in detached areas within the belt of Cecil gravelly loam which extends from the Gaston County line in a northeasterly direction to Lincolnton and beyond.

The Appling gravelly loam is not restricted to any particular position. It is found on ridge crests and divides, as well as along slopes to streams. It is generally well drained. In places surface drainage is so excessive that the surface soil washes.

Much of the Appling gravelly loam is under cultivation, although there are scattered patches of mixed oak, hickory, and pine. It is used chiefly for cotton, supplemented by corn, oats, rye, and cowpeas, in addition to garden truck and fruit. Cotton yields from one-third to three-fourths bale, corn 10 to 35 bushels, oats 10 to 30 bushels, and rye 10 to 15 bushels an acre. Cowpeas yield 1 to 2 tons of hay to the acre.

The soil is easily worked and crops mature early. It is well suited to early truck and fruit, but is inferior to the heavier Cecil soils for grass and the small grains, except possibly rye. The soil is deficient in organic matter.

Land of the Appling gravelly loam type is valued at \$15 to \$100 an acre, the price depending largely upon the location and improvement.

LOUISA SERIES.

The soils of the Louisa series range in color from gray through yellow and brown to red. The subsoils are predominantly red and highly micaceous. The material is derived from mica schists and imperfectly crystalline slates, prevailing of a pearly luster, though shades of gray, blue, pink, and purple appear. The series is represented in this county by the gravelly loam, clay loam, and clay types.

LOUISA GRAVELLY LOAM.

In its typical development the soil of the Louisa gravelly loam is a brownish, grayish, or reddish-yellow loam to fine sandy loam, ranging in depth from 6 to 12 inches. The subsoil is a light-red, friable clay with a greasy feel caused by the presence of an abundance of mica scales. The clay subsoil occasionally extends to a depth of 3 feet, but usually it grades into rotten mica-schist rock at about 20 to 30 inches, and in places the rotten rock appears at the surface. Scattered over the surface and through the soil profile is an abundance of small schist fragments, together with a scattering of quartz gravel.

The Louisa gravelly loam as typically developed has a very limited distribution. A small area occurs north of Lincolnton near Clark Creek. It is more widely developed on both sides of the South Fork of Catawba River, south of Laboratory, including the

station of Southside, and in a few small spots southwest of Lincolnton. In the vicinity of Goodsons Store the soil and subsoil lack the usual mica content, although the agricultural value is about the same. Here the type is derived from the weathering in place of phyllite, or imperfectly crystalline slates. These rocks are of various shades of color—gray, blue, pink, or purple—but all have a peculiar pearly luster. By far the greater part of the Louisa gravelly loam is embraced in a light variation which occurs in all parts of the county, with the exception of the extreme eastern part. The surface soil consists of a gray to yellowish-brown fine sandy loam to a depth of about 10 inches, where it passes gradually into a reddish-yellow, heavy fine sandy loam or light sandy clay, which at about 15 inches becomes a friable red clay. The clay usually extends beyond a depth of 3 feet. In places, however, especially nearer the water-courses, the underlying rock is exposed and the soil becomes stony.

This light variation contains very little mica. What does exist in it is very fine and occurs usually at the surface or in the lower part of the 3-foot section. The clay substratum is more compact and heavier than that of the typical Louisa gravelly loam, and the greasy feel is generally lacking. Over the surface and through the soil small, brown quartzite fragments are conspicuous, and more rarely schist and quartz gravel. This variation is derived from the weathering of schist, containing less mica than that giving rise to the typical soil.

Much of the typical Louisa gravelly loam is under cultivation, although there are scattered patches of mixed oak, hickory, and pine. The type is used principally for cotton and corn, supplemented by oats, cowpeas, garden truck, and fruit. The yields of cotton range from one-third to one-half bale an acre. Corn yields 10 to 30 bushels an acre and oats 10 to 25 bushels. Cowpeas make 1 to 1½ tons of hay to the acre. The areas of light soil are in general more productive than the typical Louisa gravelly loam.

Crops generally do better in wet than in dry years on the typical Louisa gravelly loam, as well as on the variation derived from phyllite, as these soils are inclined to be droughty. The percolation of water is facilitated by the intrusions of mica schist or phyllite, which approach the surface in almost a vertical position. In Alabama deep plowing or subsoiling and compacting of the surface with heavy rollers are resorted to in order to lessen danger from drought.

No systematic rotation of crops is generally practiced on the Louisa gravelly loam, and crop yields are usually maintained by the use of commercial fertilizers, which are used in widely varying applications.

Land of this type is valued at \$15 to \$75 an acre, the price varying with the location and the improvements.

LOUISA CLAY.

The surface soil of the Louisa clay consists of a red or dull-red, heavy clay or clay loam, containing a noticeable quantity of small mica scales. It is underlain at 5 to 8 inches by a light-red, crumbly and friable clay, in which the mica content is so great as to give the subsoil a glistening appearance and a soft, smooth, greasy feel. The subsoil usually extends to a depth of several feet, as the mica schists from which it is derived have weathered readily.

This type has a very small development. The largest bodies occur to the west and northwest of Triangle and in the vicinity of Kidville.

This type characteristically occupies rolling to hilly land, although it is level to undulating on some of the broader ridges and steep and broken along slopes flanking the stream courses. Owing to its predominantly rolling surface the type has thorough natural drainage. Much of it is excessively drained. Washing and gullying are more noticeable than on the associated soils. This is probably due to its greater content of mica, which renders the soil so friable and soft that it almost seems to float during heavy rains. Terracing and seeding to grass or clover retard the forming of gullies.

Most of this type was originally forested with red, white, and post oak, hickory, and dogwood. Practically all of it has been cleared. Many fields have been abandoned and now support a growth of old-field pine.

Corn yields 10 to 20 bushels an acre, oats 20 to 30 bushels, and wheat 10 to 15 bushels. These crops receive a light application of 8-2-2 or 8-3-3 fertilizer. Cotton produces from one-third to one-half bale per acre, with an acreage application of about 200 pounds of an 8-3-3 mixture. This soil responds quickly to liming, at the rate of 1,000 to 2,000 pounds to the acre. Soy beans, vetch, and clover can be grown to supply needed organic matter.

Land of the Louisa clay ranges in price from \$15 to \$40 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Louisa clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
233321.....	Soil.....	0.4	3.8	3.0	23.0	10.6	24.2	35.2
233322.....	Subsoil.....	.1	1.7	2.2	25.6	10.8	29.1	30.4

LOUISA CLAY LOAM.

The surface soil of the Louisa clay loam consists of a light-red or brown loam or clay having a depth of 5 to 8 inches. The subsoil is a light-red to deep-red and in spots a yellowish-red, brittle clay, slightly

more friable than the red-clay subsoil of the Cecil series. Frequently the subsoil grades into the disintegrated phyllite, shale or mica schist at about 24 to 30 inches. The Louisa clay loam is practically free from mica except locally, where the mica schist itself intrudes, and yet the substratum has a distinctly greasy feel. Over the surface is a scattering of phyllite, and less commonly schist and quartz particles, while seams or veins of quartz and schist which have resisted weathering intrude through the substratum and in places appear in narrow strata at the surface. The residual or soil material is much more shallow than the soil mantle of the Cecil clay loam type.

The Louisa clay loam occurs only in the south-central part of the county. Its greatest development is east and southeast of Lincolnton.

The surface varies from gently rolling to rolling, and drainage is generally good.

Most of the type is under cultivation, although there are scattered patches of mixed oak, hickory, and pine. Where cultivated the type is used for such general farm crops as cotton, corn, wheat, oats, and hay, in addition to garden truck and fruit. The yields of cotton range from one-third to three-fourths bale an acre. Corn yields 10 to 25 bushels, wheat 5 to 15 bushels, and oats 15 to 30 bushels an acre. Cowpeas for hay produce one-half to 1 ton to the acre. Truck crops give heavier yields than on the lighter soils, and fruits, including apples, peaches, pears, cherries, and plums, succeed.

The Louisa clay loam is slightly more productive than the typical Louisa gravelly loam, but it is less productive than the Cecil clay loam, particularly in dry years. Like the typical Louisa gravelly loam, it is inclined to be droughty, but it is a type that can be highly and permanently improved. The type in general is deficient in organic matter and in depth of top soil. Values on this type range from \$30 to \$100 an acre.

TALLADEGA STONY LOAM.

The areas appearing on the map in Louisa clay loam color but indicated by inclusion symbol represent the Talladega stony loam. The surface soil consists of a gray or brownish loam to fine sandy loam passing at about 3 inches into a yellowish or reddish loam. The subsoil, beginning at 6 to 12 inches, is a red, moderately friable clay, containing in many places a sufficient quantity of small mica scales to have a slightly greasy feel. The clay subsoil may extend to a depth of 3 feet or it may pass into the disintegrated or hard bedrock at any level between 15 and 36 inches. Distributed over the surface and mixed with the soil is an abundance of angular mica-schist and quartz-schist fragments. In places these rocks are so abundant as to make penetration with the soil auger almost impossible.

The Talladega stony loam has its greatest development in the extreme northwest corner of the county. It covers the elevation known as Buffalo Knob, which rises several hundred feet above the surrounding Piedmont Plateau level. Its slopes are steep but smooth and the surface of its crest is gently rolling. This mountain is really an outlier of the Blue Ridge.

All of the original timber has been cut, and the land is now grown up thickly in scrub oak. No use is made of this type. The lower slopes and the crest of the mountain would, if cleared, afford fairly good pasturage for sheep, goats, and cattle.

Included with the Talladega stony loam in the southeastern part of the county are two small areas of Rough stony land on Reese and Helderms Mountains. The soil material here is a gray or light-brown fine sandy loam, underlain by pale-red or yellowish-red, friable sandy clay. The soil is generally shallow and distributed in pockets. Masses of unweathered quartzite protrude. The timber cover is largely oak.

IREDELL SERIES.

The soils of the Iredell series are gray to brown in color and frequently carry iron concretions. The subsoils are characteristically plastic, sticky, waxy clays of yellowish-brown to greenish-yellow color. These soils are derived from the decay in place of diorite, schist, and gneiss. The series is represented in Lincoln County by the clay loam type.

IREDELL CLAY LOAM.

The surface soil of the Iredell clay loam, locally known as "blackjack-oak land," is a gray to brownish-gray or brownish-black loam or heavy sandy loam, ranging in depth from 2 to 10 inches. It is underlain by a brownish-yellow, greenish-yellow, or mottled yellow, green, and brown, sticky, waxy clay, which generally passes into a soft, disintegrated diorite rock at about 24 to 30 inches from the surface. The subsoil when exposed to atmospheric agencies, as observed in road cuts, assumes a dull rusty brown color. Small iron concretions or rounded pebbles are common in the surface soil.

This type is not extensive. It occupies topographic positions ranging from ridge crests to stream slopes. The surface features favor good run-off, but the impervious clay makes the internal movement of water slow.

The Iredell clay loam is not easy to work. When dry it breaks up into clods, and it does not scour readily from the plow when wet. Much of it is under cultivation, although patches still support a mixed growth of red, white, post, and blackjack oak, and, more rarely, hickory and pine. The crops chiefly grown are the staples,

cotton and corn, supplemented by oats, wheat, cowpeas, and Johnson grass.

Acreage yields on this type are reported as follows: Cotton, one-third to 1 bale; corn, 20 to 40 bushels; oats, 25 to 50 bushels; wheat, 15 to 30 bushels; cowpea hay, 1 ton to 2 tons; and Johnson grass, 3 to 4 tons.

This is an excellent soil for such general farm crops as cotton, corn, the small grains, and grass. Cotton is inclined to rust and corn to french, but these tendencies are to some extent corrected by applying kainit in quantities varying from 200 to 300 pounds per acre. The type is deficient in organic matter.

Land of the Iredell clay loam is valued at \$20 to \$40 an acre, depending upon the location and improvements.

CONGAREE SERIES.

The surface soils of the Congaree series are brown to reddish brown in color. The subsoils are generally lighter in color, but in texture and structure show considerable variation. These types are developed on the overflowed first bottoms of streams and represent soil material washed from the uplands of the Piedmont Plateau. The series in Lincoln County is represented by two types, the silt loam and the fine sandy loam, the latter shown by inclusion symbol in Congaree silt loam color.

CONGAREE SILT LOAM.

The surface soil of the Congaree silt loam is a brown or reddish-brown silt loam, grading at about 6 to 10 inches into a light-brown, compact silt loam or silty clay loam which continues downward to about 20 to 30 inches. Beneath this is a drab or bluish, plastic silty clay loam. Occasionally the type consists of 8 to 12 inches of brown silt loam overlying alternating layers of brown fine sand, fine sandy loam, and gray to bluish silty clay loam. Mica scales are conspicuous throughout the entire soil section.

The Congaree silt loam is widely developed. It occupies the first or overflow bottoms of the watercourses and represents wash from the uplands deposited by comparatively still water during overflows. Most of the type lies only a few feet above the stream channels, and this position, together with the flatness of the surface, renders drainage poor in places.

Where the land is poorly drained it supports a growth of willow, with a semiaquatic undergrowth. Most of the land where surface drainage is good is cleared, although some desirable land still supports a growth of elm, ash, oak, and poplar.

The Congaree silt loam is used almost exclusively for corn, although oats, wheat, vetch, redtop, and clover are grown to a small

extent. The yields of corn range from 35 to 70 bushels an acre. Mixed hay yields 1 ton to 3 tons to the acre, and oats for hay 1 ton to 1½ tons. The legumes seem to do especially well and reports indicate that the soil does not require inoculation for their culture.

The Congaree silt loam is an excellent soil for corn and forage crops, and it might well be devoted to these crops exclusively. The most serious problem is the prevention of overflows, which can largely be effected by straightening and deepening stream channels.

Land of this type is rarely sold alone, but with associated upland types, and the value ranges from \$15 to \$50 an acre.

CONGAREE FINE SANDY LOAM.

The areas mapped in Congaree silt loam color but indicated by inclusion symbol represent Congaree fine sandy loam. The surface soil is a brown fine sandy loam or loamy fine sand extending in depth to 10 or 15 inches. Typically, this is underlain by a light-brown fine sandy loam or silty loam, which passes into a drab or bluish silty clay, but in places the brown fine sandy loam extends throughout the 3-foot section, while in other areas fine sand or alternating layers of fine sand and silt loam appear. Mica is abundant in small scales throughout the soil and subsoil. Included with the fine sandy loam are ridges of fine sand which are well developed along the South Fork of Catawba River and are more extensive, though still in too narrow bodies to map, along the Catawba River.

The Congaree fine sandy loam is found in all parts of the county, occupying first bottoms of streams. Most of the smaller branches throughout the uplands are bordered by the type in strips too narrow to be mapped.

The Congaree fine sandy loam represents soil material washed from the uplands.

Most of the type is covered with a mixed growth of elm, ash, oak, and sycamore. Where cultivated it is used principally for corn, which yields 12 to 30 bushels an acre. Potatoes and garden vegetables do exceptionally well on this type, and it is well suited to watermelons.

Land of the fine sandy loam type is rarely sold alone, but is usually held in conjunction with adjoining soils, and ranges in price from \$15 to \$40 an acre.

SUMMARY.

Lincoln County is in the south-central part of the western half of North Carolina. It has an area of 305 square miles, or 195,200 acres.

The range in elevation is from 650 to 1,500 feet above sea level. The general slope is toward the southeast. The surface ranges from

almost level or gently rolling to rolling or broken, and presents a series of divides with deep intervening valleys. The broader inter-stream uplands include the most desirable farming land. The bottoms bordering the larger streams are predominantly level, and when well drained constitute some of the best farm land in the county. The slopes to the lowlands in general comprise the least desirable farming land.

The general drainage of the county is through the Catawba River and its South Fork.

The population of the county in 1910 was 17,132. Natural advantages favor a much more intensive agriculture, as well as a great expansion of the live-stock and dairy industries.

The climate is temperate without marked extremes of temperature either in winter or summer. The growing season is 210 days, which with the ample and well-distributed rainfall permits the production of a wide range of crops.

The principal crops are corn and cotton. These staples are supplemented by wheat, oats, hay, sweet potatoes, Irish potatoes, sorghum, and cowpeas, in addition to garden truck and fruit.

The upland soils are derived from the weathering in place of the underlying rocks and are grouped in the Cecil, Appling, Louisa, and Iredell series. The bottom-land soils, representing wash from the uplands, comprise the Congaree series.

The Cecil series is represented by the Cecil gravelly loam, sandy loam, fine sandy loam, clay loam, with a hilly phase, and clay types. The types with lighter surface soils are well suited to truck, fruit, cotton, and forage crops, while the heavier members are more suited to wheat, oats, corn, and grass.

The Louisa types are the gravelly loam, clay loam, and clay. The clay and clay loam where not excessively drained are well suited to corn, cotton, grass, and the small grains, but are less productive than the corresponding Cecil soils. The Louisa gravelly loam is an excellent type for cotton, oats, and forage crops.

The Appling series is represented by the sandy loam. This type is well suited to fruit and truck and forage crops. It produces cotton of excellent quality, but the yields are usually light.

The only Iredell type mapped is the clay loam. This is an excellent soil, where drainage is good, for such general farm crops as cotton, corn, the small grains, and grass.

The Congaree series comprises only two types, the silt loam and the fine sandy loam. In places this land is subject to overflow, but under favorable conditions it is an excellent soil for corn, truck, and forage crops.

[PUBLIC RESOLUTION--No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture "

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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