

U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF SOILS

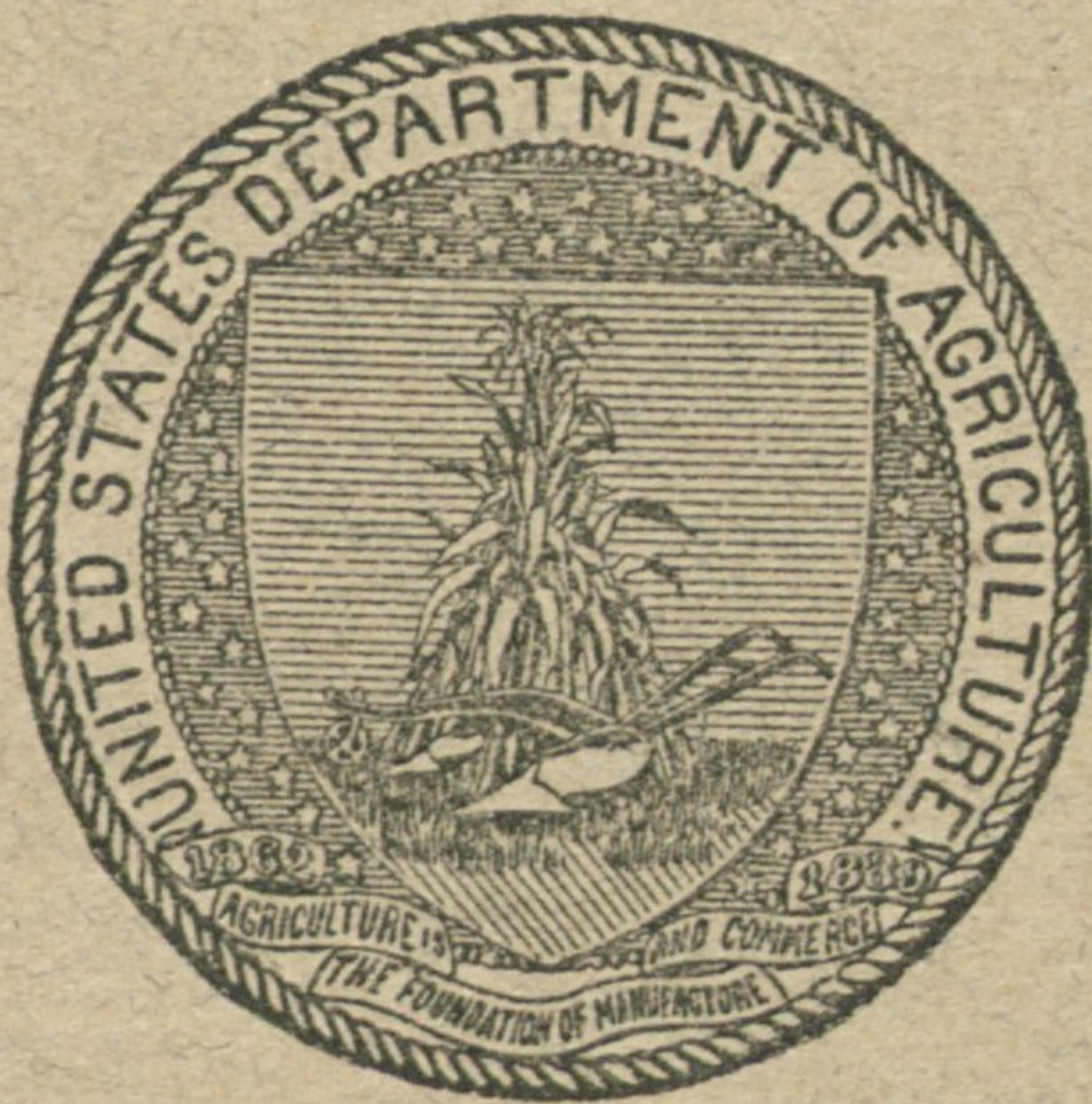
IN COOPERATION WITH THE NORTH CAROLINA DEPARTMENT OF AGRICULTURE
AND THE AGRICULTURAL EXPERIMENT STATION

SOIL SURVEY OF CUMBERLAND COUNTY
NORTH CAROLINA

BY

S. O. PERKINS, OF THE U. S. DEPARTMENT OF AGRICULTURE,
IN CHARGE, AND W. A. DAVIS AND S. F. DAVIDSON,
OF THE NORTH CAROLINA DEPARTMENT OF
AGRICULTURE

[Advance Sheets—Field Operations of the Bureau of Soils, 1922]



WASHINGTON
GOVERNMENT PRINTING OFFICE
1925

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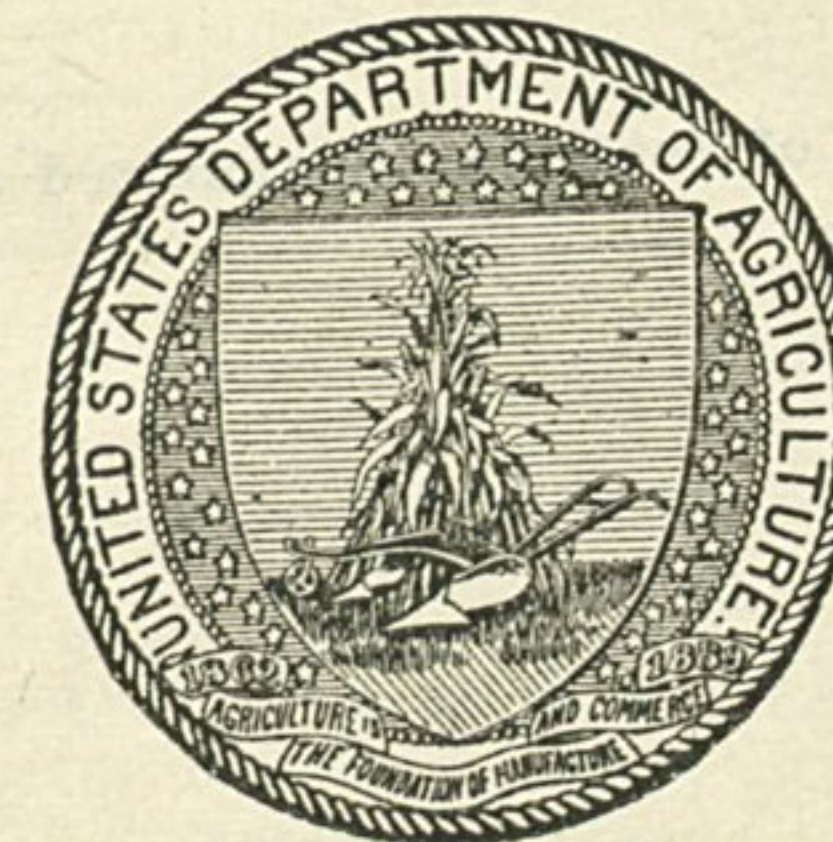
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[PUBLIC RESOLUTION—No. 9.]

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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MAP

Soil map, Cumberland County sheet, North Carolina

III

SOIL SURVEY OF CUMBERLAND COUNTY, N. C.

By S. O. PERKINS, of the U. S. Department of Agriculture, in Charge, and W. A. DAVIS and S. F. DAVIDSON, of the North Carolina Department of Agriculture

DESCRIPTION OF THE AREA

Cumberland County is situated in the south-central part of North Carolina, about 50 miles south of Raleigh, its position in the State being shown on the small map on this page. It has an area of 647 square miles, or 414,080 acres.

Cumberland County consists of a plain sloping southeastwardly, the slope being greater in the northern third. From a point 5 or 6 miles north of Fayetteville southeastward the slope is less per mile than to the north. The plain is dissected by shallow valleys, those of the larger rivers being 4 or 5 miles wide, while the greater number are narrow. The depth of the larger valleys is less than 60 feet below the upland immediately adjacent to them.

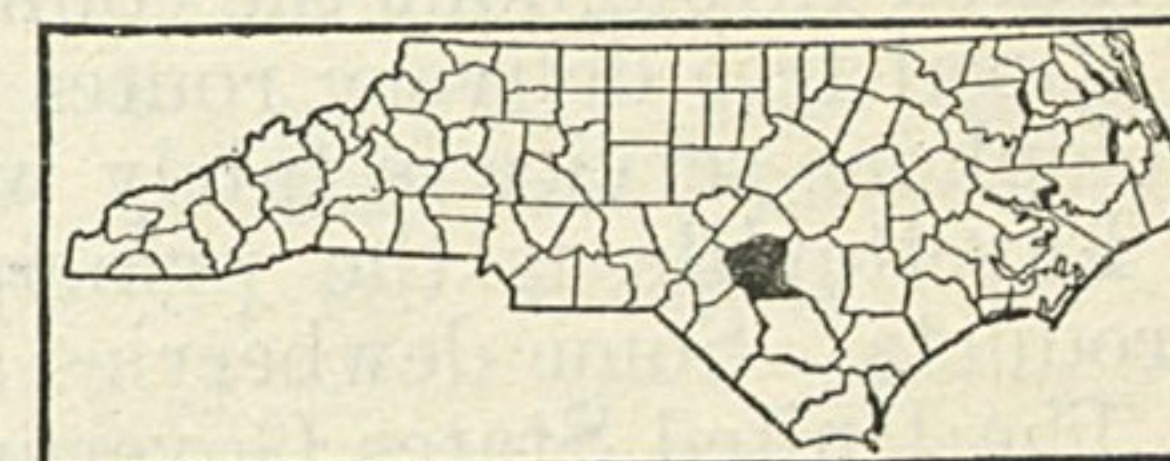


FIG. 4.—Sketch map showing location of the Cumberland County area, North Carolina

The northwestern part of the county, which is the highest and which slopes to the southeast at a relatively rapid rate, is called the sand-hill region and the rest is known as the flatwoods region.

Fayetteville, situated nearly in the center of the county, has an elevation of 100 feet at the railway station; about three-fourths of a mile farther west the elevation is 208 feet above sea level; and Coollyconch Mountain, in the northwestern part in the U. S. Artillery Reservation, is probably the highest point in the county, with an elevation, according to the United States Geological Survey, of 410 feet above sea level.

Cumberland County was formed in 1754 from Bladen County, and is one of the oldest counties in the State. The first settlers were mostly of Scotch and English descent. They located on the broad terrace lands along the Cape Fear and Little Rivers.

The population of the county in 1920, according to the census, was 35,064, of which 26,187 was classed as rural, including all inhabitants except those in Fayetteville. The present population consists mostly of descendants of the early settlers, along with a considerable number of negroes. The population is not equally distributed, depending mainly on the character of the soil. The most sparsely settled sections are in the northern part of the county and in the southeastern part along the Bladen County line east of the Cape Fear River. The population is rather evenly distributed throughout the remainder of the county, the most thickly settled sections being in the northeastern part and on the second bottoms along the Cape Fear River.

Fayetteville, the county seat, is the largest town, with a population of 8,877. Hope Mills, Cumberland, Linden, Wade, Stedman, Godwin, and Falcon are small villages scattered over the county.

Transportation facilities in the county are excellent. The main line of the Atlantic Coast Line Railroad runs in a southwesterly direction through the county. The Wilmington and Mount Airy branch of the same railroad crosses the county in a general southeasterly direction, the Fayetteville branch of the Norfolk Southern Railroad terminates at Fayetteville, and the Aberdeen & Rockfish Railroad runs from Fayetteville to Aberdeen, Moore County. The Cape Fear River affords boat transportation from Fayetteville to Wilmington for the greater part of the year.

The county has an excellent system of sand-clay and gravel-surfaced roads leading into almost every section. They are well maintained and remain in good condition throughout the year. Both the National and the Capital Highways pass through Fayetteville.

Schools are being consolidated and modern brick buildings erected to accommodate about 300 pupils to the school. Churches are distributed throughout the county.

Rural free delivery routes reach almost every home in the county. Telephone service is fairly well established.

Fayetteville is the principal market for nearly all the county products. Some dewberries are shipped to northern markets.

The United States Government has purchased the greater part of what is known as the sand-hill region of the county for an artillery range. This reservation is named Fort Bragg, and comprises an area of about 49½ square miles, or 31,507.55 acres, in Cumberland County.

CLIMATE

The following table, compiled from the records of the Weather Bureau station at Fayetteville, gives the normal monthly, seasonal, and annual temperature and precipitation for the county:

Normal monthly, seasonal, and annual temperature and precipitation at Fayetteville

[Elevation, 170 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1909)	Total amount for the wettest year (1908)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December.....	43.9	78	2	4.14	1.38	3.60	0.9
January.....	43.9	81	4	3.89	.96	3.07	1.2
February.....	44.0	81	-5	4.38	3.61	4.90	3.8
Winter.....	43.9	81	-5	12.41	5.95	11.57	5.9
March.....	54.2	90	15	4.71	1.80	6.12	.1
April.....	60.7	94	28	3.57	1.80	3.21	T.
May.....	72.3	100	37	4.16	5.18	3.47	.0
Spring.....	62.4	100	15	12.44	8.78	12.80	.1

Normal monthly, seasonal, and annual temperature, etc.—Continued

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1909)	Total amount for the wettest year (1908)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
June.....	76.4	102	49	4.61	5.31	6.28	.0
July.....	79.2	103	54	6.56	3.65	6.25	.0
August.....	77.9	102	51	6.43	6.86	13.54	.0
Summer.....	77.8	103	49	17.60	15.82	26.07	.0
September.....	72.4	100	39	4.19	2.91	2.03	.0
October.....	62.5	93	28	3.35	.85	2.78	T.
November.....	51.9	86	16	2.64	.21	1.16	T.
Fall.....	62.3	100	16	10.18	3.97	5.97	T.
Year.....	61.6	103	-5	52.63	34.52	56.41	6.0

The mean annual temperature is 61.6° F., and the mean annual rainfall 52.63 inches. The precipitation is distributed fairly well throughout the year, being heaviest during the growing season. Crops seldom suffer from severe drought and never are a total failure. The winters are usually mild and pleasant and zero weather is rare.

The dates of the latest recorded killing frost in the spring and of the earliest in the fall are April 21 and October 12, respectively. The average dates of the last killing frost in the spring and of the first in the fall are March 30 and November 4. The average length of the growing season is 219 days, which is sufficient for the maturing of all crops grown in this region. Soybeans and peas will mature after a crop of small grain, giving two crops in one year. In this mild climate clovers, small grain, and some kinds of vegetables can be grown throughout the winter.

AGRICULTURE

Agriculture has always been the principal industry in the territory now embraced by Cumberland County. The early settlers produced corn, rye, and wheat, together with a little indigo, flax, and barley. The canebrakes and the growth of wild peas and various grasses furnished pasturage for cattle and other livestock, and the income of the settlers was derived largely from the sale of cattle, hogs, and sheep. The county was originally heavily forested with longleaf pine. This pine is rich in resin, and the production of turpentine soon became important. The lumber industry was next developed, and as the timber was cut larger fields were cleared and put into cultivation. There was such an abundance of land that when the fertility of the fields deteriorated to a point where they no longer produced profitable crops they were abandoned and fresh land was brought under cultivation. Little attention was given to maintaining the productiveness of the fields. The early plantations were, of necessity, largely self-sustaining, as all the food products

were produced on the farm and practically all the clothing was homemade.

Fayetteville was one of the early trading centers or distributing points in North Carolina. Long before the advent of the railroads products from a large section of the Piedmont Plateau and even from the mountains were hauled through the country and marketed here. The tobacco grown upstate was rolled in hogsheads to this point, where it was loaded on boats which plied the Cape Fear River. This means of transportation had an important bearing on the early agricultural development of Cumberland County.

According to the census of 1880, corn and cotton were the principal crops grown 40 years ago. There were 32,677 acres of corn and 9,210 acres of cotton in 1879; oats occupied 1,509 acres; wheat, 1,141 acres; rye, 1,513 acres; and sweet potatoes, 1,116 acres. At this time, however, Cumberland County had slightly more than 1,000 square miles of territory. By 1889 the acreage of cotton had increased to 17,253 acres; the acreage to corn had made a slight increase, while the other crops remained about stationary, except for a small increase in the production of hay. In 1899 cotton was grown on a somewhat smaller area than 10 years before, corn had made a slight increase, and cowpeas had become an important crop, occupying 3,635 acres. There was also some tobacco grown, and a larger acreage of tame grasses. By 1909 the production of cotton had increased to 28,313 acres, and cowpeas were grown on 13,382 acres. In addition there was an increase in the production of grains cut green, peanuts, sweet potatoes, other vegetables, and fruit crops. The production of peaches and other tree fruits and also of dewberries had increased from the previous years, and some fair-sized commercial orchards of peaches had become established.

The size of Cumberland County at the present time (1922) is 647 square miles, and in studying the agricultural development of the county it should be kept in mind that the figures for the years prior to 1910 relate to the county when it contained about 1,000 square miles.

At present the agriculture of Cumberland County consists of the production of cotton as the principal cash crop and of corn as the main subsistence crop.

According to the census of 1920, there were 34,964 acres devoted to the production of cotton in 1919, which yielded 24,695 bales. Cotton is to-day, as it has been for a long time, practically the only cash crop of the county.

Corn is grown on the next largest acreage and is the main subsistence crop. In 1919 it occupied 32,038 acres and produced 536,080 bushels. It is fed to work stock, cattle, and hogs, and is ground into meal for home consumption. The production is not sufficient to meet the local demand, and some corn is shipped in each year.

According to the census, there were 1,133 acres in tobacco in 1919, producing 630,382 pounds. Tobacco is becoming an important cash crop, and it is probable that the acreage devoted to it will continue to increase, owing to the infestation of cotton fields by the boll weevil.

Wheat and oats have not had a large part in the agriculture of this county. They have been grown successfully by a few farmers and they can be grown in many sections of the county with good yields.

The hay and forage crops include tame grasses, grains (wheat, oats, rye) cut green, soybeans, cowpeas, and corn fodder. In 1919, according to the census, the production of these amounted to 7,358 tons. "Tops" are cut and fodder is pulled from the cornstalks and cured and used for feeding work stock. Oats and vetch combined are grown for hay by some farmers. Rye is often sown as a cover crop and for winter pasturage. There is not enough hay and forage produced in the county to meet the local demand and much is shipped in each year.

Sorgo (saccharine sorghum) is grown on nearly every farm in small patches for the manufacture of sirup for home use.

The successful growing of peaches in Moore County and in neighboring counties, and also the coming of the boll weevil, induced many farmers of this section to plant considerable areas of peaches. According to the census, there were 15,303 trees of bearing age and 3,082 younger trees in the county in 1920. It is reported that this year (1922) 15,000 more trees have been put out, and a plan is under way to organize a fruit growers' association. In the near future, therefore, this section will probably become one of the fruit-growing sections of the South. The Elberta, Carman, Belle (Belle of Georgia) and Mayflower are the most popular varieties. Excellent transportation facilities favor fruit growing in this section.

The commercial production of dewberries is carried on to some extent and such fruits as pears, cherries, muscadine grapes, plums, and strawberries are grown in a small way. All kinds of vegetables are grown in this county, the soil and climate of which seems to be well adapted to such crops. Among these, early peas, tomatoes, onions, radishes, lettuce, beets, snap beans, turnips, and celery are grown for the local markets. Other crops of secondary importance are potatoes, sweet potatoes, soybeans, velvet beans, and peanuts.

The raising of cattle for beef is of little importance in this county, though cattle and hogs are raised on nearly every farm, principally for home consumption. The surplus products are marketed locally. Practically all the work stock is imported.

Dairying is carried on in a small way, the surplus production of dairy products being barely enough to supply the demand in Fayetteville and other towns. One or more cows are kept on nearly every farm in the county to furnish milk and butter for home use. The 1920 census reported the value of dairy products in 1919, exclusive of the milk and cream used in the home, as \$87,041.

There are several poultry farms in the county, and in 1919 the value of all poultry products was \$164,149.

As reported by the 1920 census, the total value of all agricultural products in 1919 was \$7,555,736. The value of animals sold or slaughtered is not included in this amount.

The adaptation of certain soils to particular crops is generally recognized. The Ruston sandy loam, Norfolk sandy loam, Norfolk fine sandy loam, Ruston fine sandy loam, Wickham sandy loam, Wickham fine sandy loam, and Wickham sand are good soils for most

all crops, but are better for cotton. Cotton is grown all over the county and on all soils except those of the low wet depressions. The Cape Fear loam is especially adapted to corn, oats, cabbage, and onions; celery also probably would do well on this soil. The better drained areas of this type are sometimes planted to cotton and these give large yields. The Roanoke silt loam, sandy loam, and fine sandy loam, Coxville silt loam and fine sandy loam, Leon sand, St. Lucie sand, Norfolk sand, Altavista sand, and Kalmia sand are recognized as the less productive soils of the county. The Portsmouth sand, St. Johns sand, and Plummer sand are considered of extremely low value from an agricultural standpoint, although in places the Portsmouth sand and St. Johns sand are held at a high price for the growth of juniper trees, which are valuable for shingles and telephone poles. The other sand soils are recognized as better for certain orchard fruits, dewberries, and early truck crops.

Fall breaking of the land is not a general practice unless a cover crop is to be grown. A few farmers who own tractors break their heavy lands deep in the fall and make use of different cover crops, but most prefer to do shallow breaking in the spring. Sometimes two furrows are thrown together, the crop is planted on the ridges thus formed, and the rest of the surface is broken as the crop is cultivated. This seems to be a poor method. Shallow cultivation with light implements is the general practice. On the sandy soils light-running farm implements can be used, but the heavier lands of the county require heavier machinery and work stock. A number of large farms are equipped with modern machinery, such as heavy 2-horse plows, disk harrows, harvesters, threshers, hay balers, mowing machines, and 2-horse cultivators, and on a few there are tractors; but for the greater part the farming is done by tenants and small landowners, and small work stock and light farm implements are in general use. The extension of the use of tractors on the heavier lands would seem practicable.

The farm buildings would be classed as fair. The best farmers have comfortable houses with modern conveniences. The barns and storage buildings upon these farms are large enough to house the stock and store the necessary feed. These buildings ordinarily are in a good state of repair.

No systematic crop rotation is practiced in this county. The most popular rotation or alternation used by the better farmers consists of cotton the first year, corn the second year, with some cover crop, followed by oats and vetch the third year. Many of the farmers are growing cowpeas, crimson clover, oats, rye, soybeans, velvet beans, and vetch as soil improvers and as cover crops.

A successful crop rotation, based on experiments made by a very progressive farmer, is being followed on his farm, which consists largely of Cahaba sandy loam and artificially drained Kalmia sandy loam. The first year a crop of wheat or oats is harvested, and is followed by a crop of cowpeas; the cowpea seed is picked, the vines are plowed under, and lime is applied at the rate of 1,000 pounds per acre; the second year cotton is grown, followed by crimson clover or rye; the third year corn or some other crop is grown. This rotation appears to be a good one for nearly all the soils of Cumberland County.

Another rotation recommended by the North Carolina Experiment Station for this section, especially on the better-drained terrace soils and the heavier upland soils, consists of corn the first year, with cowpeas or soybeans; second year, peanuts, followed by oats and vetch; third year, cotton, with crimson clover.

All soils of the county, with the exception of the black terrace soils along the Cape Fear River and a few black heavy upland soils, receive large quantities of commercial fertilizer for all crops grown. An 8-3-3¹ mixture is generally used for all farm crops, although a home mixture composed of 16 per cent acid phosphate and 7½ per cent cottonseed meal and analyzing about 6-4-0 or 8-4-0 is used on some farms. Cotton usually receives the heaviest application, averaging 500 to 800 pounds per acre, and corn 300 to 500 pounds. A later top-dressing of 50 to 100 pounds per acre of nitrate of soda commonly is given both crops. Tobacco is fertilized with 600 to 1,000 pounds per acre of an 8-3-3 mixture. From 200 to 300 pounds is commonly used for wheat and oats, followed by a top-dressing of sodium nitrate at the rate of 50 to 100 pounds per acre. In commercial peach orchards each tree usually receives 4 to 6 pounds of a 6-4-0 or 8-3-3 mixture. The total expenditure for fertilizer in 1919, as reported by the 1920 census, was \$1,030,315. The fertilizer was used on 88.3 per cent of the farms in the county.

From year to year the farmers are realizing more and more the importance of growing legumes as soil improvers. The expenditure for nitrogen can be greatly reduced by plowing under cover crops; this practice will also improve the tilth of the soil and help to prevent the leaching out of plant-food elements.

In 1920, 37 per cent of the farms reported an expenditure of \$214,599 for farm labor, or an average of \$187.10 per farm reporting. Farm labor at present is plentiful. The monthly wages range from \$20 to \$30, with board. Day laborers receive an average of \$1 per day. Cotton is usually picked at so much per pound.

Most of the farms in Cumberland County range in size from 20 to 300 acres. There are a few having 800 to 2,000 acres, but these large farms generally represent cut-over or hay land.

According to the 1920 census report, 54.1 per cent of the farms were operated by owners, 45.7 per cent by tenants, and 0.2 per cent by managers. Nearly all the tenant farms are worked on a share basis. Under the share system in general use in this county the landowners furnish land, cottonseed, and fertilizer, and the tenants furnish stock, tools, and implements and do all the work, and the crops are divided equally. In addition to half of the general crops, the tenant usually gets his garden and sorgo patches free.

The price of land ranges from \$10 to \$200 an acre, depending on the quality of the soil, nearness to towns, and good roads. The cheapest land is in the sandy section and in the southeastern part of the county.

Cumberland County affords excellent opportunities in the way of favorable climatic conditions and an abundance of fairly cheap land, which is adapted to a wide variety of crops.

¹ Percentages, respectively, of phosphoric acid, nitrogen, and potash.

SOILS ²

Cumberland County lies in the higher part of the Coastal Plain region of the State, and includes in its northwestern part a portion of the typical sand-hill section. The rest and greater part of the county is representative of the normal Coastal Plain in both topography and soils.

Most of the soils of this county are light in color, ranging from light gray or yellowish gray to light brown. There are, however, considerable areas of black soils in the southeastern part of the county.³ All the light-colored soils are relatively low in organic matter, as the conditions of good drainage and a forest cover have not favored the accumulation of vegetable matter in the soil. The black soils contain much organic matter, which has accumulated as a result of a long-continued swampy condition favoring a heavy growth of vegetation and retarding the decay of plant remains.

Leaching has been active in the majority of the soils of this county. All the important factors, the loose, porous structure of the soils, excellent drainage, and a heavy rainfall in a comparatively warm climate, have been favorable to such action. This leaching out of the readily soluble minerals is reflected in a relatively low content of soluble plant food in the soils. Most of the soils in this county, basing the opinion on the chemical analysis of similar soils in near-by localities, in all probability contain a comparatively low percentage of nitrogen, phosphoric acid, and potash; this should be true especially of the sands and many of the sandy loams.

Within the light-colored and dark-colored soil groups there are six subgroups depending on similarities independent of color. The first of these subgroups comprises the sand and sand-hill soils, which occupy extensive areas in the northwestern and western parts of the county, particularly south of Fayetteville and in the vicinity of Hope Mills. This subgroup includes the light-gray to yellowish-gray sand with yellow loose sand subsoil extending to a depth of 3 feet or more (Norfolk), and an associated soil (Hoffman) occupying some of the steeper slopes, particularly in the sand-hill section. The latter consists of light surface material underlain by a friable, brittle, variegated sandy clay.

The second subgroup includes types with gray to light-brown surface soils over friable sandy clay subsoils, which are either reddish yellow or yellow in color. These are types of the Ruston and the Norfolk series and constitute the important general farming lands in the county. They are developed in the west-central part of the county, especially to the north and west of Fayetteville.

²The soils of Cumberland County join well with those of the surrounding counties except in a few places. These discrepancies are due to changes in soil classification based on a better understanding of the soils. Since the older surveys of Robeson and Harnett Counties were made the Dunbar series has been established. As a consequence the Dunbar sandy loam adjoins an area of Norfolk sandy loam along the Atlantic Coast Line Railroad in Robeson County. An area of Dunbar very fine sandy loam is mapped against Norfolk silt loam in Harnett County to the east of Cape Fear, and north of Fort Bragg an area of Norfolk sand adjoins the sand-hill phase of the Norfolk sand in Harnett County.

³The light-colored soils of the county are neutral in character or only slightly acid; the black soils are commonly strongly acid. Practically all of the soils respond to the application of lime, and the black lands require heavy applications in order to produce the most profitable yields; particularly is this true of Hyde loam, Portsmouth loam, Cape Fear loam, and Okenee loam. This is borne out by field experiments with lime in other parts of eastern North Carolina.

A third subgroup of soils occurs in the eastern and southeastern parts of the county. Here the surface soils are prevailingly gray, and the subsoils are heavy, tough, and in many places somewhat plastic clays to heavy sandy clays, mottled yellow, gray, or red, and brownish yellow. The natural drainage of these soils is not as good as that of the preceding subgroup, owing in large measure to the structure of the subsoil which does not permit the free circulation of air and water. This third subgroup includes the Dunbar, Coxville, and Plummer types.

The fourth subgroup comprises those soils which have a hardpan layer, locally known as "sand rock," occurring at varying depths in the subsoil. This hardpan has a brown or coffee-ground color and consists of sand cemented by iron salts and organic acids. In some places it is rather hard, though penetrable with a soil auger, while in other places it is fairly soft. This group includes types of two distinct series, the almost white to gray Leon and the black types classed as St. Johns. These soils for the most part are poorly drained, the hardpan layer interfering with the internal movement of water.

The fifth subgroup of soils is developed in the extreme southeastern part and a few other places in the eastern part of the county. It includes the black soils of the Hyde and Portsmouth types, developed in what are known as bays or pocosons. In the heavier types the subsoil may be a sandy clay or heavy clay, and such areas when reclaimed make good farming lands. A quicksand forms the subsoil of the Portsmouth sand.

The sixth subgroup includes the second-bottom or terrace soils that occupy a strip of country 4 or 5 miles wide along the Cape Fear River and form narrower areas along the other rivers and larger creeks. These soils vary in color of surface soil from light gray or brown to black and in texture of subsoil from friable to plastic clay or heavy clay.

The upland soils of Cumberland County owe their origin to the weathering of marine sediments consisting of beds of unconsolidated sands, sandy clays, and heavy clays. These materials were brought down from the Piedmont Plateau and Appalachian Mountains and deposited on the floor of a sea that once covered this region. Since their elevation above sea level these materials have undergone much change through weathering, in the way of leaching, oxidation, de-oxidation, and aeration. The second-bottom or terrace soils and also those of the first bottoms have been formed of materials washed from the uplands, transported by the rivers and creeks, and deposited at times of overflow.

In mapping the soils of Cumberland County 40 distinct types have been recognized. These types have been arranged into series on the basis of differences of color, structure, topography, origin, and drainage conditions. The following paragraphs give briefly the salient features of the various series groups.

The upland soils of the county comprise types of the Norfolk, Ruston, Hoffman, St. Lucie, Leon, St. Johns, Dunbar, Coxville, Plummer, Portsmouth, and Hyde series.

The types of the Norfolk series are mapped throughout both the sand-hill and flatwoods sections of the county. The surface soils are light gray to brownish gray and the subsoil is a yellow loose sand

or yellow friable sandy clay. The Norfolk sand, loamy sand, sandy loam, and fine sandy loam are mapped.

The Ruston series includes upland types with gray to grayish-brown surface soils, and a reddish-yellow to yellowish-red, friable sandy clay subsoil. The series is represented in the county by the sand, the sandy loam with a deep phase, and the fine sandy loam.

The Hoffman series is confined to the sand-hill section. This series includes types with light-gray soils, underlain by mottled red, yellow, pink, white, and purple subsoil. One type, the Hoffman sandy loam, occurs in the county.

The types of the St. Lucie series are composed of white or very light gray, loose, incoherent sands extending to a depth of 3 feet or more. Only one type, the St. Lucie sand, is mapped in Cumberland County.

The types included in the Leon series are characterized by light-gray surface soils which rest upon a hardpan layer of brown or coffee-ground color, beneath which the material is an incoherent sand. This series is developed in the flatwoods section of the Coastal Plain. It is represented in Cumberland County by the Leon sand.

The St. Johns soils, which are closely associated with the Leon, differ from the latter in that the surface drainage is not so good and the surface soil is black, instead of light gray. The St. Johns sand is the only type of the series developed in Cumberland County.

The types of the Dunbar series have gray surface soils and a yellow rather heavy upper subsoil that grades into a rather heavy, tough, mottled yellow, gray and red lower subsoil. These types are somewhat like the Norfolk in the surface soil and upper subsoil and like the Coxville in the lower subsoil. The Dunbar sandy loam and very fine sandy loam are developed here.

The Coxville series includes types with gray to dark-gray surface soils and a dull-gray upper subsoil that grades into a tough lower subsoil of plastic clay, mottled yellow and gray and splotched with red. The Coxville is a flatwoods series of poorly drained soils. The sandy loam, fine sandy loam, and silt loam are mapped.

The types of the Plummer series have gray soils and a mottled gray and yellow or brown, sticky sandy clay subsoil. Drainage is deficient. The sand and sandy loam are mapped in this survey.

The Portsmouth series includes types with dark-gray to black surface soils and a gray or mottled gray and yellow sandy clay or clay subsoil for the heavier types, and a gray sand subsoil for the sand types. These soils are poorly drained. The Portsmouth sand and the loam are mapped.

The types included in the Hyde series are characterized by black surface soils and a heavy subsoil which is either black or drab in color. These soils need drainage to fit them for agriculture. The series is represented in Cumberland County by the Hyde loam.

The second-bottom or terrace soils developed along the Cape Fear River have been formed of material washed mainly from the Piedmont region. These soils have been grouped in the Wickham, Altavista, Roanoke, and Cape Fear series.

The types of the Wickham series have light-brown to brown surface soils and a reddish-yellow to yellowish-red clay subsoil, compact and rather heavy, or a reddish-brown subsoil of sandy tex-

ture. The Wickham sand, sandy loam, and fine sandy loam are typically developed in Cumberland County.

The types included in the Altavista series have gray surface soils and a yellow or slightly mottled yellow and gray friable subsoil. The sand, sandy loam, and fine sandy loam are mapped in the present survey.

The Roanoke series comprises types with gray to dark-gray surface soils and a heavy, tough, and slightly plastic clay subsoil, mottled gray and yellow and occasionally red. The types are poorly drained. The sandy loam, fine sandy loam, and silt loam are developed in this county.

The types grouped in the Cape Fear series are characterized by black surface soils and by steel-gray to light-gray or brownish-gray heavy subsoil. The soils are developed on reworked and re-deposited Piedmont material which was formerly in a swampy condition favoring the accumulation of organic matter. They occupy level areas and naturally are poorly drained. Only one type, the Cape Fear loam, is mapped.

The second-bottom or terrace soils formed from material washed from the Coastal Plain soils have been grouped with the Kalmia, Cahaba, Myatt, and Okenee series. These soils lie above ordinary overflow.

The Kalmia series includes types with light-gray surface soils and a yellow friable subsoil mottled slightly with light gray. The Kalmia sand, sandy loam, and fine sandy loam are mapped.

The types in the Cahaba series differ from those of the Kalmia mainly in that the surface soils are slightly brown and the subsoil is reddish yellow or yellowish red and has a compact but friable structure. Only one type, the Cahaba sandy loam, is developed in the present area.

The types correlated as of the Myatt series are characterized by dull-gray surface soils, and a mottled gray and yellow, sticky, sandy clay subsoil. These soils are poorly drained. The Myatt sandy loam is mapped.

The Okenee series includes types having black surface soils and a rather heavy, tough, gray to drab subsoil. These soils in their natural condition are wet to semiswampy. Only the loam of the series occurs in this county.

The first-bottom soils consist of material that has been washed from the uplands and deposited on the present flood plains of the stream. The material derived from the Piedmont soils has given rise to soils of the Congaree series. The material washed from the Coastal Plain soils gives rise to types in the Chastain series.

The Congaree series comprises alluvial types with brown surface soils and a brown to light-brown subsoil, the material of which contains typically fine mica scales. One type, the silt loam, is mapped.

The Chastain series includes types with gray surface soils and a tough, slightly plastic subsoil of gray or mottled gray and brown color. It is represented here by the Chastain loam.

Swamp is the name applied to material of varying texture existing in the first bottoms in a permanently wet condition and therefore not separable into types.

In subsequent pages of this report these various soil types are described in detail and their relation to agriculture is discussed.

The accompanying map shows the distribution of the soils, and the following table gives their actual and relative extent:

Areas of different soils

Soil	Acres	Per cent	Soil	Acres	Per cent
Norfolk sand	99,840	24.1	Roanoke fine sandy loam	5,504	1.3
Hoffman sandy loam	33,472	8.1	Hyde loam	5,440	1.3
Ruston sandy loam	18,688	7.7	Norfolk fine sandy loam	5,312	1.3
Deep phase	13,376		Kalmia sandy loam	4,928	1.2
Norfolk loamy sand	19,776	4.8	Altavista sand	3,648	.9
Roanoke silt loam	19,648	4.7	Chastain loam	3,264	.8
Swamp	16,512	4.0	Coxville sandy loam	3,200	.8
Norfolk sandy loam	16,320	3.9	Ruston sand	3,200	.8
Portsmouth sand	15,232	3.7	Wickham sand	2,688	.6
Dunbar sandy loam	13,184	3.2	Kalmia fine sandy loam	2,688	.6
Leon sand	12,160	2.9	Kalmia sand	2,624	.6
Wickham sandy loam	10,752	2.6	Okenee loam	2,496	.6
Wickham fine sandy loam	8,832	2.1	Ruston fine sandy loam	2,304	.6
Coxville silt loam	8,448	2.0	Altavista fine sandy loam	2,304	.6
Roanoke sandy loam	7,872	1.9	St. Johns sand	2,112	.5
Portsmouth loam	7,360	1.8	Congaree silt loam	1,280	.3
Dunbar very fine sandy loam	6,464	1.6	Cahaba sandy loam	1,280	.3
Cape Fear loam	6,400	1.6	Myatt sandy loam	832	.2
Coxville fine sandy loam	6,144	1.5	St. Lucie sand	576	.1
Altavista sandy loam	6,016	1.5			
Plummer sandy loam	6,016	1.5			
Plummer sand	5,888	1.4	Total	414,080	

NORFOLK SAND

The surface soil of the Norfolk sand consists of 1 to 2 inches in the wooded areas or 4 to 6 inches in cultivated fields, of gray to light-gray sand in places slightly loamy. The color is due to the decay of grasses and leaves in the forest and cultivation and vegetable matter in the fields. This is underlain by a yellow loose sand extending to a depth of 3 feet or more. This sand does not extend downward indefinitely, however. In most places the bottom of the sand layer could not be reached with the 3-foot auger, but that it is underlain by clay or sandy clay material is shown clearly by the occurrence of Hoffman soils on the sides of all the valleys that have been cut to more than a few feet in depth in the Norfolk sand region. The Hoffman soils consist of this sandy clay material with a thin coating of sand or sandy loam on top. The clay beneath the Norfolk sand is occasionally shallow enough to be reached with a 3-foot auger within the Norfolk sand area, but this is rare. The thickness of the sand layer in the Norfolk sand will average probably as much as 6 feet.

In places, as along the National Highway in the vicinity of East-over School, and other places in the eastern part of the county, the surface soil is gray and the subsoil is a reddish-yellow or light-brown sand. Some small areas of Ruston sand also are included with this type, being too small to separate. Part of the large body between Fayetteville and Hope Mills is a little finer in texture than many of the larger areas in other parts of the county. Over a greater part of this type, however, the Norfolk sand is fairly uniform in color and texture.

This type is mapped in all parts of the county, but by far the greater part is west of Cape Fear River. The largest continuous area lies just southwest of Fayetteville in the vicinity of Hope Mills,

where it occurs in rather broad interstream areas, and near the crests of the more gentle slopes of ridges or stream divides. Other large areas are developed in the northwest corner and in the United States Artillery Reservation. Throughout the eastern and southeastern parts of the county, east of the Cape Fear River, the type occupies narrow ridges of slight elevation.

The topography of the type ranges from nearly level or gently undulating to gently rolling or rolling, and the drainage everywhere is excellent. The more rolling and hilly areas are found along the northwest border and along the western side.

The Norfolk sand is not an important soil, although it occupies by far the largest area in the county. About 30 per cent of it is under cultivation in the eastern part of the county, but not more than 5 to 10 per cent of it is being cultivated west of the Cape Fear River. The original forests consisted of a dense growth of longleaf pine. To a great extent these have been cut off, only small patches remaining here and there. Most of these are in the southeastern part of the county. The forked-leaf blackjack oak, a variety of scrub oak, turkey oak, and a few scattering longleaf pines, with an undergrowth of wire grass, some dwarf huckleberry, and wild vetch, constitute the predominating plants in the present growth on the uncultivated land. Wherever the forked-leaf blackjack oak is found the land is generally considered very poor. The small proportion of the land under cultivation is due to the low yields obtained from general farm crops. With the introduction of such special crops as peaches, dewberries, and tobacco, much more of this land is being cleared.

The main crops on the Norfolk sand at present are cotton and corn. Less important crops are rye, oats, cowpeas, velvet beans, sweet potatoes, and garden vegetables, grown mostly for home use, the surplus being sold on the local market. Cotton yields one-quarter to two-thirds bale per acre, corn yields from 5 to 15 bushels per acre. Bright-leaf tobacco has been grown by some farmers very successfully. About 800 pounds of 8-4-3 or 8-3-3 fertilizer is used for cotton, and less of the same kind of fertilizer is used for corn. About 1,000 pounds of 8-3-3 is used for tobacco, which yields 500 to 800 pounds per acre. Cantaloupes, watermelons, sweet potatoes, and other vegetables yield well when heavily fertilized. The selling price of this land ranges from \$10 to \$35.

In many sections of the South the Norfolk sand is used successfully for the production of early truck crops for the northern markets. It is naturally a poor general farming soil, but the special crops can be profitably grown with the use of commercial fertilizer. The incorporation of organic matter by plowing under cowpeas, velvet beans, soybeans, and rye will increase the productiveness of the soil.

NORFOLK LOAMY SAND

The Norfolk loamy sand is shown on the map by cross lines upon the color of Norfolk sand. It is a gray to yellowish-gray, compact loamy sand, passing at 6 to 9 inches into a pale-yellow loamy sand, which grades at 15 to 20 inches into a yellow, friable, clayey sand, and in places into a friable sandy clay at 28 to 36 inches. In some

places the yellow sandy clay subsoil appears at about 24 inches. These areas would have been mapped Norfolk sandy loam, deep phase, if they could have been separated readily. Spots of Ruston loamy sand also are included with this type, and in a few places the subsoil consists of material representing a gradation between the Norfolk and the Ruston.

The Norfolk loamy sand occurs mainly on the slight elevations between the "bays" and swamps in the eastern half of the county. The largest of these lie $2\frac{1}{2}$ miles east of Wade and between McMillan Church and Bethany School on the east side of Browns Swamp. The type usually occupies flat, low ridges. The surface is nearly level, but owing to the friable nature of both soil and subsoil drainage is generally good.

This is quite an important type of soil, especially in the eastern part of the county, where it is the principal agricultural soil. About 75 per cent of it is under cultivation. Upon the remainder the timber growth consists mainly of dogwood, hickory, post oak, black-jack oak, water oak, shortleaf pine, and few scattering longleaf pine. Wire grass and dwarf huckleberry bushes constitute the chief undergrowth.

Cotton, corn, and tobacco are the main crops. Cotton yields one-third to 1 bale per acre, averaging about two-thirds bale. Corn yields 15 to 40 bushels per acre, averaging about 20 bushels. Tobacco yields from 500 to 1,000 pounds per acre, with an average of about 700 pounds.

All crops usually receive a heavy application of fertilizer. From 500 to 800 pounds of an 8-3-3 or 8-4-3 mixture is used for cotton. Corn, if planted after a crop on which a large amount of fertilizer was used, does not get very much at time of planting, but a top-dressing of nitrate of soda is added later at the rate of 75 to 100 pounds per acre. The selling price of this land ranges from \$20 to \$50 an acre.

The Norfolk loamy sand is deficient in organic matter, which can best be supplied by growing and turning under such crops as cowpeas, vetch, soybeans, velvet beans, and rye. Occasional liming and systematic rotation of crops including legumes also would increase the productiveness of the soil.

NORFOLK SANDY LOAM

The surface soil of the Norfolk sandy loam is a light-gray or yellowish-gray, mellow, medium loamy sand 6 to 9 inches deep in cultivated fields, underlain by a pale-yellow light sandy loam or loamy sand which extends to a depth of 9 to 14 inches. In virgin areas the upper layer, a few inches thick, is dark gray, with a light-yellow layer underneath. When these layers are plowed and mixed together, the surface soil is light gray or slightly yellowish gray. The subsoil is a yellow to greenish-yellow, friable sandy clay, extending to a depth of 3 feet or more.

This type is fairly uniform in texture, but in the low places or slight depressions the surface soil has a dark-gray color, owing mainly to a higher content of organic matter, and the subsoil is somewhat mottled with gray, yellow, and red, resembling that of the

Dunbar sandy loam. Small spots of the Norfolk sandy loam occur in shallow depressions in association with the Ruston sandy loam.

Norfolk sandy loam is one of the strongest soils in the county, and probably 75 per cent of it is under cultivation; the rest has a forest growth mainly of dogwood, hickory, shortleaf pine, oaks, cedar, holly, and a few scattering longleaf pines.

Cotton is the principal crop. Enough corn usually is grown to supply the demands of the home and for feeding stock and hogs. Little tobacco is grown. Cowpeas, soybeans, vetch, and rye are planted on most of the farms as soil improvers. Some seed is gathered from the cowpeas and soybeans. Oats, potatoes, sorgho, crimson clover, vetch, fruits, berries, vegetables, and grapes are minor crops that do well on this type. This is a good all-round soil. It warms up early and is suited to the production of watermelons, cantaloupes, and many kinds of early vegetables. Turnips and collards do well during the winter.

In some of the gently rolling places near streams the subsoil is a mottled yellow and red, heavy, sticky, sandy clay; these areas would have been mapped Dunbar sandy loam if they had been large enough to show on the map. This variation is noticeable in the vicinity of Falcon.

The Norfolk sandy loam occurs in rather broken areas throughout the smoother sections in the southwestern and northeastern parts of the county. The largest development in broken areas is in the northeastern part of the county. The largest area in one body is located 2 miles east of Roslin. Some small areas occur in the sand-hill section; the largest of these is about 5 miles west of Linden.

The topography is prevailingly gently undulating to almost flat, becoming gently rolling as the larger streams are approached. Drainage is good; rain water passes away rapidly and cultivation can be resumed in a short time after a heavy rain, where the soil has a good supply of organic matter. Crops on this type rarely suffer from drought.

The best farmers usually make from one-half bale to $1\frac{1}{2}$ bales of cotton per acre, averaging about three-fourths bale. Corn yields range from 15 to 50 bushels per acre, averaging about 25 bushels. Cotton usually receives an acreage application of 600 to 800 pounds of an 8-3-3 or 8-4-3 mixture. Corn generally gets from 50 to 100 pounds of nitrate of soda about the time the corn begins to tassel. When corn is planted after cotton, many farmers do not use any fertilizer at all on the corn at planting time, depending upon the residual effect of those applied on the cotton, and there appears to be enough left in the soil in most cases to produce a good corn crop. The liberal use of commercial fertilizer, however, is the general practice for all crops. The suggestions for the improvement of the Ruston sandy loam are applicable to this type.

The selling price of this land at present (1922) ranges from \$40 to \$150 an acre, depending on the location and improvements.

NORFOLK FINE SANDY LOAM

The surface soil of the Norfolk fine sandy loam is a light-gray to a yellowish-gray light fine sandy loam or loamy fine sand, passing into a pale-yellow fine sandy loam at about 4 to 8 inches and extending to

a depth of 10 to 18 inches. The subsoil is a yellow, heavy, but friable fine sandy clay extending to a depth of 3 feet or more. In the eastern and northeastern parts of the county, where it borders the Dunbar very fine sandy loam and Coxville silt loam, the surface soil has a finer texture than typical. In some of the flatter areas in the eastern part of the county some mottling of gray appears in the subsoil, similar to that of the Dunbar very fine sandy loam. In the vicinity of Marvin Church small areas of Ruston fine sandy loam were included with the type.

The Norfolk fine sandy loam is not an extensive type. Its largest development, in the vicinity of Marvin Church, contains about 4 square miles. Another area three-quarters mile southwest of Bethany School is about 2 miles long and one-quarter mile wide. Another fairly large area lies in the northeastern part of the county, 2 miles northeast of Rhodes Mill. Smaller areas are scattered over the eastern half of the county.

The topography is undulating to gently rolling. Natural drainage is good, except in a few low places, which can be drained very easily by means of open ditches or drain tile.

Probably 90 per cent of this type is under cultivation. The original growth was mainly longleaf pine. The present growth is mostly shortleaf pine, oaks, hickory, and dogwood.

The Norfolk fine sandy loam is one of the best soils in Cumberland County. It is easy to cultivate and is well adapted to all crops grown in this section. As a whole it is probably a little more productive than the Norfolk sandy loam. The same crops are grown as on the latter, and the same methods of cultivation and fertilization are followed. Identical to somewhat higher yields are obtained.

Land of this type sells at \$50 to \$125 an acre, depending on nearness to towns and good roads.

RUSTON SAND

The Ruston sand consists of a grayish-brown to dull-brown medium sand to a depth of 5 to 8 inches, passing into a reddish-yellow to yellowish-brown medium sand, which extends to a depth of 3 feet or more. In places both soil and subsoil are somewhat loamy; this condition is noticeable in an area lying about 1 mile west of Sycamore School. The type as a whole is slightly more coherent than the Norfolk sand.

The Ruston sand occurs in small areas in this county and has a small total area. Two of the largest areas lie in the vicinity of Sycamore School and Eastover School. The next largest area is 2½ miles east of Cumberland Union Church. A few smaller bodies are found in the southwestern part and one in the United States Military Reservation. The type is confined mostly to gentle slopes or slightly rolling areas bordering swamps or larger streams. The area in the United States reservation occupies a valleylike position, but the surface is gently undulating to gently sloping. This particular area is somewhat loamy, having a rich-brown loamy sand surface soil and a reddish sand or loamy sand subsoil. Drainage everywhere is good.

This type of soil is stronger and more productive than the Norfolk sand. It warms up early and is easily tilled. About 75 per cent

of it is under cultivation. Shortleaf pine, post oak, and scattering longleaf pine constitute the principal tree growth, although hickory, dogwood, walnut, and persimmon are found in places. Cotton and corn are the main crops. Tobacco, sweet potatoes, rye, cowpeas, soybeans, and velvet beans do well. The type is also used for nearly all kinds of truck crops, and watermelons and cantaloupes do well.

Cotton yields from one-fourth to 1 bale per acre, averaging about three-fourths bale. Corn yields from 10 to 30 bushels per acre, averaging about 15 bushels, and tobacco yields from 500 to 900 pounds per acre. Cotton usually receives an application of 400 to 800 pounds of an 8-3-3 or 8-4-3 mixture, and corn receives 300 to 500 pounds of the same kind of fertilizer. Tobacco gets 500 to 1,000 pounds of fertilizer. The price of this land ranges from \$20 to \$50 an acre.

RUSTON SANDY LOAM

The surface soil of the Ruston sandy loam in uncultivated areas is a light-brown to gray, light sandy loam or loamy sand, 2 to 5 inches deep, passing into a pale-yellow sandy loam extending to a depth of 12 to 18 inches. The subsoil is a reddish-yellow to yellowish-red, friable sandy clay, which extends to 3 feet or more. The surface soil in cultivated fields is a light-gray loamy sand 7 to 9 inches deep. In places the subsoil is mottled yellow and red. This type represents a gradation between the Norfolk and the Orangeburg sandy loam, the latter having a brownish-gray surface soil and a deep-red subsoil.

Small areas of the Orangeburg sandy loam, too small to warrant their separation, were included with this type. These occur principally on the breaks as the streams are approached. One noticeable body is 2 miles west of Westover School on the break west of a little stream. Another spot is 1 mile east of Eureka School.

A few low spots or depressions are scattered throughout the Ruston sandy loam type, which have a dark-gray surface soil, with either a yellowish-red, reddish-yellow, yellow, or mottled yellow and red, sticky sandy clay subsoil. The dark color of the surface soil is due to accumulation of organic matter and lack of drainage. These areas would have been mapped as a separate type if they had been larger. They remain in a moist condition most of the time and are usually used for oats or some other feed crop. Cotton is seldom planted in these low places.

Another variation occurs on some of the slopes where the surface soil is washed off, leaving the reddish subsoil exposed. Small areas of Norfolk sandy loam and of Ruston sandy loam, deep phase, are also included with this type.

The Ruston sandy loam has a larger development in one body than any other soil in the county. An almost unbroken area averaging about 3 miles wide extends from a point just west of Fayetteville to the Hoke County line. A smaller area lies in the vicinity of Eureka School, and a few occur in other parts of the county.

The topography varies from undulating to gently rolling and in a few places strongly rolling as the larger streams are approached. Drainage for the most part is well established. Water does not

remain on the surface after a rain and little time is lost from cultivation, but the crops are seldom damaged as a result of drought, especially where the content of organic matter is maintained.

This is a very important soil in the county, and about 80 per cent of it is in a high state of cultivation. The rest supports a forest growth mainly of white oak, black oak, post oak, broadleaf black-jack oak, shortleaf pine, holly, dogwood, and some longleaf pine and hickory.

Cotton is the main crop. On most farms, however, enough corn is grown for home use. Wheat and oats are grown and give good yields. Cowpeas, soybeans, velvet beans, rye, crimson clover, and vetch are grown both for hay and as soil improvers. Sweet potatoes, cherries, bush fruits, vegetables, grapes, sorgo (saccharine sorghum), and peanuts are also grown to supply the needs of the farm. Nearly every farmer grows some watermelons and cantaloupes, mostly for home use, but sometimes a few are sold. Cotton yields from one-half bale to $1\frac{1}{2}$ bales per acre, averaging about 1 bale. Corn yields from 15 to 35 bushels per acre; wheat, 8 to 20 bushels, averaging about 12 bushels; oats, 25 to 40 bushels. Soybeans yield from 12 to 20 bushels of seed or 1 to 2 tons of hay per acre.

Ready-mixed and home-mixed fertilizers analyzing 8-3-3 or 8-4-3 are in common use. Applications range from 500 to 800 pounds for cotton and from 300 to 500 pounds for corn, with a later top-dressing of nitrate of soda at the rate of 75 to 100 pounds per acre for corn and sometimes for cotton. Wheat and oats as a rule receive 200 to 400 pounds per acre of the same mixture and a top-dressing of 50 to 100 pounds of nitrate of soda applied in the spring. Cowpeas and soybeans are frequently sown after wheat or oats or in the corn at laying-by time, without fertilizer.

The present selling price of this land ranges from \$80 to \$150 an acre, according to location and improvements.

The most economical way to improve this soil apparently is to grow legumes more extensively in rotation with the clean-cultivated crops; to increase the supply of organic matter by occasionally plowing under a summer legume, or a crop of vetch or clover and oats or rye combined; to grow more feed crops, such as corn and coarse forage; and to raise more livestock, so as to use more economically the crops produced and incidentally return the greater part of the fertilizing elements to the soil in the form of manure.

Ruston sandy loam, deep phase.—The Ruston sandy loam, deep phase, has a surface layer of gray to grayish-brown loamy sand, from 2 to 5 inches deep in the woods and averaging about 7 inches in cultivated fields. This is underlain by a pale-yellow light sandy loam to loamy sand to a depth of 20 to 30 inches. Below this is a yellowish-red or reddish-yellow friable sandy clay. This phase is like the Ruston sandy loam, except in the greater depth to the sandy clay subsoil, a slightly lighter texture, and a somewhat more uniform color at the surface. Included with this phase are spots of Ruston sandy loam and Norfolk sand, but these, owing to their small size, could not be separated satisfactorily.

This phase is associated with the Ruston sandy loam and the Norfolk sand. The largest areas are located along and south of the National Highway, about 3 miles southeast of Clifton, north of

Eureka School, and on both sides of Little Cross Creek. Other areas lie in the middle-western part of the county.

The topography ranges from undulating to gently rolling and broken on some of the slopes to streams. Drainage is excellent, and on some of the slopes the run-off is excessive and terracing is necessary.

The Ruston sandy loam, deep phase, is a fairly important soil. Probably one-half of it is under cultivation; the rest is in forest, mainly of blackjack oak, dogwood, hickory, shortleaf pine, and some longleaf pine. The phase is utilized for the same crops as the Ruston sandy loam, but the yields are not as high. Cotton yields from one-third to 1 bale per acre, averaging about one-half bale; corn, from 15 to 25 bushels per acre. The same kinds and same amounts of fertilizers are used on this phase as on the type.

The selling price of this land in farming sections ranges from \$30 to \$100 an acre.

RUSTON FINE SANDY LOAM

The surface soil of the Ruston fine sandy loam consists of a gray to yellowish-gray or pale-yellow, mellow fine sandy loam. In wooded areas 1 or 2 inches of the surface is dark gray or brown, and in cultivated fields it is light gray or yellowish gray. The subsoil, beginning at about 12 to 18 inches, is a yellowish-red or reddish-yellow, friable fine sandy clay.

Ruston fine sandy loam is an inextensive type in this county. It is developed mainly in the southwestern part in the vicinity of Marvin Church and south of King Hiram School. Smaller areas occur in the northeastern part of the county along the Harnett County line.

The topography is level or undulating to gently rolling. Surface and internal drainage is good. Owing to its small area, this is not an important type, although it is an excellent soil. Probably 70 per cent of it is under cultivation. The rest supports a forest growth consisting mainly of oak, hickory, dogwood, and pine.

Cotton, corn, cowpeas, and oats are the principal crops. Wheat, rye, and soybeans do well. Crimson clover, vetch, sweet potatoes, and vegetables are also grown. Cotton yields from one-half bale to $1\frac{1}{2}$ bales per acre. Corn yields from 15 to 40 bushels per acre. Oats and wheat give fair yields. The acreage applications and grades of commercial fertilizer used are the same as on the other soils of the Ruston and Norfolk series. Some of the best farmers grow legumes and rye and turn them under as green manure, but the majority rely mainly on commercial fertilizer.

This type sells for the same price as the adjoining Norfolk fine sandy loam. The suggestions given for improvement of that type are applicable to the Ruston fine sandy loam.

HOFFMAN SANDY LOAM

The surface soil of the Hoffman sandy loam consists of a gray loamy sand to light sandy loam, passing at 1 to 3 inches into a pale-yellow sandy loam, which extends to depths ranging from 7 to 20 inches. The upper subsoil is usually a dull-yellow or reddish-yellow,

heavy sandy loam to sticky sandy clay, in places showing slight pinkish color. The lower subsoil is a compact gritty sticky clay or a smooth soaplike clay of variegated colors, generally mottled yellow, red, pink, and white, with yellowish red predominating as a rule. This extends to a depth of 3 feet or more. In places the lower part is a bluish-gray, red, pink, and white, smooth, plastic clay.

On some of the knolls there are sharp ridges and abrupt slopes where erosion has nearly kept pace with weathering and the soil mantle consequently is shallow. In such eroded areas the subsoil usually has a brick-red color, due to oxidation of the iron compounds, and iron concretions and fragments of ferruginous sandstone are common. The soil material here is prevailingly coarser than in the less broken areas along some of the more gentle slopes. Where the sand hills join the Ruston soils the surface soil is more loamy, the subsoil is more uniform in color, and contains fewer mica flakes, and the land, therefore, is of greater agricultural value.

In the northwestern part of the county, now included in the United States Artillery Reservation, there are some areas, the most noticeable one being a flat ridge in the rifle range, in which the surface soil is a reddish-brown to red sandy loam and the subsoil a bright-red, sticky, sandy clay. These areas would have been mapped as Greenville sandy loam if they had been large enough to warrant separation. Around Coollyconch Mountain there are a few included bodies of Guin sandy loam, which is a mixture of Greenville, Hoffman, Ruston, and Norfolk soils, containing numerous fragments of ferruginous sandstone.

The Hoffman sandy loam occurs throughout the sand-hill section of the county, closely associated with the Norfolk sand. It occupies practically all of the rolling stream slopes and reaches over the crests of some of the narrow ridges. There are a few nearly level to gently rolling areas on some of the interstream ridges, but the topography in general is gently rolling or rolling to broken. Drainage is good to excessive, and the run-off in many places has caused erosion.

This type is not important. By far the greater part of it lies within the United States Artillery Reservation. Of the rest, not over 3 per cent is under cultivation, for most of the type outside of the reservation is so broken and eroded as to be unfit for agriculture. The forest growth consists mainly of round-leaf and forked-leaf blackjack oaks, dogwood, second-growth shortleaf pine, hickory, and scattering longleaf pine. Originally this type supported a heavy growth of longleaf pine. Wire grass, stunted huckleberry bushes, and wild vetch constitute the undergrowth.

Cotton and corn are grown in small patches. Peaches, dewberries, sweet potatoes, and vegetables do very well on this type if properly handled. With a liberal use of fertilizer, tobacco gives fair yields. This land is usually sold in connection with the Norfolk sand and sells for the same price.

ST. LUCIE SAND

St. Lucie sand consists of a light-gray to nearly white, loose, incoherent sand, with a depth of 3 feet or more. In places the surface soil contains enough organic matter to give it a light-gray color, but

this is exceptional. Included with this type are small spots of white or light-gray sand underlain by an orange-yellow medium to fine sand, which would have been mapped as Lakewood sand if the area were large enough.

The St. Lucie sand occurs in a few small areas in the eastern part of the county. One of the largest lies about 3 miles west of Stedman. It occupies slight ridges and knolls and has excellent drainage. This type is not used for agriculture. It supports a small growth of forked-leaf blackjack oak and a few scattering longleaf pines.

LEON SAND

The Leon sand consists of a light-gray to dark-gray sand, 1 to 3 inches deep, underlain by a light-gray, almost white, loose, incoherent sand which may extend to depths of 8 to 24 inches, but usually ranges in depth from 12 to 20 inches. Below this is a dark-brown or coffee-ground colored to nearly black, dense hardpan layer, from 2 to 20 inches thick, and this is underlain by a white sand, which is always wet and compact, but has the nature of quicksand when disturbed.

Near the boundary line of the Portsmouth soils, the surface layer, 2 or 3 inches thick, consists of black loamy sand. Included with the Leon sand are small areas of Portsmouth sand, Plummer sand, and St. Johns sand so small and intricately mixed that separation could not be made.

The Leon sand is confined to the eastern half of the county, with the exception of a small area 1 mile east of Roslin, in the southwestern part of the county. The type has a level to slightly undulating surface and lies at an elevation slightly higher than the St. Johns sand and the Portsmouth soils and lower than the associated Norfolk sand. It occupies principally the flat ridges which form the divides of some of the streams in the flatwoods. Drainage on most of it is good, except in some low places where the elevation is only very slightly higher than the St. Johns sand. The surface is saturated during the winter months. The hardpan layer prevents the capillary rise of moisture from the underlying wet sand during the dry season.

Practically none of this type is under cultivation and it is generally considered of extremely low agricultural value. It is used mostly for grazing. In places it supports a growth of longleaf pine. Other vegetation consists mostly of wire grass and gallberry and dwarf huckleberry bushes. This land is usually burned over in early spring to permit the wire grass to come up fresh. The greater part of the longleaf pine has been cut for lumber and the rest is boxed for turpentine.

This type of soil sells at \$5 to \$25 an acre, depending upon location with respect to good roads and the quantity of timber still standing.

The soil is rather difficult to improve, but might be used for some crops if the hardpan layer were broken by deep subsoiling or blasting, allowing the moisture to rise. By adding considerable organic matter and making heavy applications of fertilizer and lime, some vegetables could be grown on the soil.

ST. JOHNS SAND

The St. Johns sand is shown on the map by crosslines over the color used to indicate the Portsmouth sand. The St. Johns sand, from 5 to 12 inches in depth, consists of a dark-gray to black sand, loamy sand, to mucky loam, grading into a dingy-gray to almost white loose sand. This is underlain at depths ranging from 12 to 30 inches, usually from 14 to 20 inches, by a black to dark-brown or "coffee-colored" compact sand or so-called hardpan locally known as "sand rock." This hardpan layer, ordinarily 2 to 5 inches thick with a range from 1 to 20 inches, is underlain by a brown sand which grades into gray to nearly white, compact, wet sand, which, when disturbed, is incoherent and flows like quicksand.

The black color of the surface soil is due to a high content of organic matter, which varies from barely enough to give it a dark color to quantities sufficient to give it a mucky character, the latter condition occurring in depressed or swampy areas. The outer edges of these areas are closely associated with the Leon sand.

The St. Johns sand, which is not extensive, is developed in the flatwoods section in the eastern part of the county. The largest areas lie one-half mile west of White Pond Bay, 2 miles southeast of Cedar Creek, and 3 miles southwest of McMillan Church. Smaller areas occur in other parts of the eastern section of the county. The topography is flat or slightly depressed and drainage is poor.

The type is not used for agriculture. In places it has a good growth of juniper, and such areas are held at a fair price. Land of the St. Johns sand should be devoted to forestry.

DUNBAR SANDY LOAM

The surface soil of the Dunbar sandy loam consists of a gray sandy loam, 5 to 8 inches deep, underlain by a pale-yellow friable sandy loam to sandy clay loam, which extends to a depth of 10 to 15 inches. The subsoil is a yellow, mottled with gray and bright-red, heavy, slightly plastic fine sandy clay. In the wooded areas a surface layer, 2 to 4 inches thick, is darker gray than in the cultivated fields, and as a whole this type has a slightly darker surface than the Norfolk soils. In places the subsoil is somewhat friable.

The Dunbar sandy loam is developed throughout the flatwoods section of the county. With respect to color, structure, and topography it is intermediate between the Norfolk sandy loam and the Coxville soils. The surface is predominantly flat, ranging to undulating and gently rolling near the stream courses. The surface drainage is fairly well established on most of this type, but the underdrainage is poor.

This is a soil of moderate extent with a total area of 13,184 acres, or 3.2 per cent of the area of the county. The largest areas are in the vicinity of Stedman, 1 mile east and north of McMillan Church, and in the southwestern part of the county. Probably 20 per cent of the type is under cultivation; the rest has a forest growth mainly of shortleaf pine, hickory, oaks, maples, and scattering longleaf pine. Most of the type is cut-over land and progress has been slow in reclaiming it for agricultural use.

Cotton, corn, oats, and soybeans are the principal crops grown. Sweet potatoes, potatoes, wheat, crimson clover, and velvet beans are grown successfully. Cotton yields from one-third to three-fourths bale per acre, with an average yield of about one-half bale; corn 10 to 30 bushels per acre, with an average of about 15 bushels; and oats yield 20 to 35 bushels, with an average of about 25 bushels.

The kinds of fertilizer and the quantities used are the same as on the Norfolk sandy loam. When better drainage has been provided the methods for improving the Norfolk sandy loam are applicable to this type. The selling price ranges from \$20 to \$80 an acre, depending on location and improvements.

DUNBAR VERY FINE SANDY LOAM

The Dunbar very fine sandy loam consists of a light-gray very fine sandy loam to silty loam, from 4 to 8 inches deep, underlain by a pale-yellow, heavy very fine sandy loam extending to a depth of 10 to 18 inches, and passing into a yellow, heavy, slightly plastic silty clay, mottled with gray and red, which extends to 3 feet or more. In the wooded areas the surface layer of 1 or 2 inches is dark gray and ranges from a silt loam to a very fine sandy loam. On some of the gently rolling areas near the streams the surface soil contains a somewhat greater proportion of fine sand. In a few of the more poorly drained spots the subsoil is a heavy plastic clay similar to the lower subsoil of the Coxville fine sandy loam.

This type is confined wholly to the eastern half of the county in the flatwoods section. The largest areas lie in the northeastern part, northwest of Godwin, and smaller areas are scattered throughout the eastern side of the county. The type occupies a position slightly higher than the Coxville soils and lower than the Norfolk. The areas in the vicinity of Godwin lie at a slightly higher level and are better drained than those in the southern part between Sycamore School and Evergreen School.

The topography is flat to undulating and slightly rolling as the streams are approached. Surface and internal drainage are both poor, and ditching is necessary to fit the land for agriculture.

The Dunbar very fine sandy loam is one of the less extensive types of the county and not important agriculturally. About 20 per cent of it is under cultivation; the rest supports a forest growth, mainly of pine, oaks, maple, and sweetgum. Cotton and corn are the main crops, with soybeans, oats, wheat, and rye next in importance. Cotton yields from one-third to two-thirds bale, and corn 10 to 20 bushels per acre. Oats and wheat give moderate returns. Sweet potatoes and garden vegetables are grown with fair success. Cotton usually receives from 500 to 800 pounds and corn 300 to 400 pounds of fertilizer analyzing 8-3-3 or 8-4-3.

This type sells at \$20 to \$100 an acre, depending on location and improvements.

The Dunbar very fine sandy loam is a compact soil which is deficient in organic matter. This can best be supplied by growing soybeans, cowpeas, velvet beans, rye, and crimson clover, turning under at least one of these crops every year or two. Deeper plowing would be beneficial.

COXVILLE SANDY LOAM

The surface soil of the Coxville sandy loam consists of a dark-gray to nearly black, heavy sandy loam, 3 to 8 inches deep, underlain by a steel-gray or drab, heavy, sticky sandy loam to sandy clay loam extending to a depth of 10 to 18 inches. The subsoil proper is a heavy sticky sandy clay to tough plastic clay mottled gray, yellow, brown, and red. In places no red mottlings are found. In other small areas the surface soil is nearly black and the subsoil a brownish gray to mottled yellow and gray, heavy, plastic sandy clay, similar to the subsoil of the Portsmouth sandy loam but considerably heavier and more plastic.

The type is of small extent. The most important areas lie north of Stedman; smaller areas occur in other parts of the county. The type occupies low, flat situations and slight depressions. Its drainage is poorly established.

This is not an important soil type. Probably less than 10 per cent of it is under cultivation; the rest supports a forest growth, mainly of shortleaf pine, sweetgum, and maple. Corn and oats are the leading crops; soybeans, cowpeas, and rye do well.

This type of soil needs to be drained to make it suitable for the production of crops. With proper drainage, deeper plowing, turning under leguminous and cover crops, a systematic crop rotation including a legume, and liming every three or four years, this type should give good yields of corn, cotton, oats, soybeans, and cowpeas.

The price of land of this type ranges from \$10 to \$50 an acre, depending on location, character of forest growth, and nearness to towns or good roads. Small areas near Stedman are held at higher prices.

COXVILLE FINE SANDY LOAM

The surface soil of the Coxville fine sandy loam consists of a dark-gray fine sandy loam to very fine sandy loam, passing at 4 to 6 inches into a gray, slightly mottled, sticky fine sandy clay loam which extends to a depth of about 10 to 14 inches. The subsoil is a mottled drab, steel-gray, ochreous-yellow, and bright-red, heavy, plastic clay, extending to a depth of 3 feet or more. In places the surface is almost black, owing to the presence of organic matter, and the texture is a silty to very fine sandy loam. Some of the areas lying north and east of Big White Pocoson have a very fine sandy loam texture. Locally the subsoil may be a mottled yellow and gray or drab, heavy, plastic clay, without any red mottling.

This type is one of relatively little importance. A fair-sized area, about one-fourth mile wide in the narrowest place and 1 mile in the widest and about 7 miles in length, lies just north and east of Big White Pocoson. A few other areas occur in the eastern part and a few spots in the southwestern part of the county. The type has a low, flat, or depressed topography and is poorly drained.

None of this type is under cultivation. The forest growth consists mainly of shortleaf pine, maple, holly, and sweetgum. With proper drainage the land should give fair yields of corn, oats, and soybeans.

COXVILLE SILT LOAM

The surface soil of the Coxville silt loam consists of a light-gray to dark-gray silt loam to silty clay loam 6 to 8 inches deep. The subsoil usually begins as a mottled gray and yellow, compact silty clay loam to tough silty clay, which becomes heavier and more plastic with depth and shows mottlings of bright red at a depth of 18 to 30 inches.

Certain variations from the above description appear here and there. In places the surface layer, 2 or 3 inches thick, is nearly black silty loam. In other places the surface is a gray very fine sandy loam. Areas having the latter surface soil are commonly underlain by a mottled yellow and red, tough, plastic clay subsoil. Another variation in the subsoil consists of a light-gray or steel-gray, heavy, plastic clay, with or without occasional mottlings of yellow and red.

One area about 2 miles southwest of Cedar Creek, bordering a small stream near the Cape Fear River, has a gray surface soil averaging about 5 inches, underlain by a mottled yellowish-brown, reddish-brown, yellow, gray, and red, very heavy, impervious, plastic clay. This area would have been mapped Susquehanna silty clay loam if it had been larger. Small areas of Coxville fine sandy loam and very fine sandy loam are also included with this type.

The Coxville silt loam is confined principally to the flatwoods section in the eastern part of the county. The largest area is a continuous strip beginning about 3 miles west of Stedman and extending southeast a distance of about 9 miles. Fair-sized areas occur in other places in the eastern part of the county.

The topography is prevailingly flat to slightly depressed. In the depressions water stands on the surface part of the year. Owing to the heavy texture of the surface soil and the plastic structure of the subsoil, the type is naturally poorly drained and only a few patches are in cultivation. It supports a timber growth mainly of gum, maple, water oak, and a few shortleaf pine. This type sells at \$10 to \$25 an acre, depending upon its location and timber growth.

The Coxville silt loam, by means of draining, liming, deep plowing, and turning under rye, soybeans, and other crops as green manure, could probably be made to produce very good crops. In its natural state it is hard to handle and bakes when plowed. The incorporation of large quantities of organic matter should improve the physical condition.

PLUMMER SAND

The Plummer sand consists of a light-gray to dull-gray sand, 5 to 8 inches deep, underlain by a light-gray sand, usually in a saturated condition, extending to a depth of 3 feet or more. In a few places the surface soil is dark gray, owing to accumulation of vegetable matter.

This is one of the unimportant types of the county, covering in all less than 6,000 acres. It occurs in a number of spots throughout the eastern, northwestern, and southeastern sections of the county. The largest body is in the vicinity of Cumberland Union Church. A conspicuous narrow area lies east of Sycamore School.

The Plummer sand occupies level or slightly depressed areas and also very gently sloping positions at the base of slopes or areas in the neighborhood of the heads of small streams. It is naturally poorly drained, as it receives the seepage waters from higher lying soils, which keep it in a saturated condition the greater part of the year. It is difficult to drain because the loose sand acts like quicksand and the walls of the ditches will not stand up.

Practically none of this type is under cultivation and it is not considered of much value except for grazing or for forestry. The present vegetation consists principally of black gum and shortleaf pine, with an undergrowth of gallberry bushes and myrtle. In many places sedges and pitcher plant are conspicuous plants.

PLUMMER SANDY LOAM

The surface soil of the Plummer sandy loam consists of a light-gray to gray heavy sandy loam, 7 to 10 inches deep. The subsoil is a light-gray to bluish-gray, mottled with light-brown and yellow, sticky sandy clay. Both soil and subsoil are darker in color when moist. This type in its natural condition is fairly well supplied with organic matter, but is not as easy to cultivate as the lighter Norfolk soils.

The Plummer sandy loam occurs in irregular-shaped areas scattered through the eastern or flatwoods section of the county. The type is prevailingly level. It lies slightly higher than the Portsmouth and St. Johns soils and a little lower than the Norfolk. Owing to its flat topography and the structure of the subsoil, the drainage is poor.

The total area of Plummer sandy loam in Cumberland County is 6,016 acres. Very little of it is in cultivation; most of it supports a forest growth, mainly of oak, sweetgum, and shortleaf pine, with an undergrowth of gallberry and huckleberry. The pitcher plant is a characteristic growth in many places.

Cotton, corn, and oats are the principal crops. Soybeans, velvet beans, cowpeas, and sweet potatoes are minor crops. Cotton yields from one-fourth to one-half bale per acre, corn from 10 to 20 bushels, and oats from 12 to 20 bushels. Soybeans and cowpeas produce fair yields of hay. The same kinds and quantities of fertilizer are used on this soil as on the Norfolk sandy loam and loamy sand. The present selling price of land of the Plummer sandy loam type ranges from \$10 to \$30 an acre.

Plummer sandy loam is a cold, damp soil, slow to warm up, plant growth being somewhat backward in the spring. Ditching is necessary to fit the land for farm crops. Better drainage, liming, deeper plowing, and the growing and turning under of leguminous crops, would greatly improve the land for farming.

PORTSMOUTH SAND

The Portsmouth sand, locally known as "pocosons" or "bays," consists of 6 to 14 inches of dark-gray to black medium sand or loamy sand to mucky sand, high in organic matter, underlain by a light-gray to nearly white, loose, incoherent sand, locally known as "quicksand." The lower subsoil is always saturated, flows like quicksand,

and will not stick to the auger. In the center of the large depressions the surface is a black loam or peaty muck, sometimes extending to a depth of 15 to 20 inches. At the margins, where the areas are associated with Leon, Norfolk, and Plummer sand, the surface is sandy, with just enough organic matter to give it a dark-gray color. Patches of St. Johns sand and Portsmouth loam are included with this type as mapped.

The Portsmouth sand occurs in scattered areas, known as "bays" or "pocosons," throughout the flatwoods section of the county. The largest areas are in the southeastern part of the county along the Bladen County line. The surface is level and slightly depressed. There is very little run-off, and most of the type is either saturated or covered with water during a considerable part of the year.

This type is rather extensive but has little agricultural value, and none of it is under cultivation. It supports a dense growth of shortleaf pine, juniper, cypress, and bay, with an undergrowth mainly of gallberry and huckleberry bushes and briers. Most of the land is used for pasture. The juniper trees are valuable for the manufacture of shingles and for use as telephone poles and make a rapid growth if fire is kept out. This soil can not be drained easily, because the ditches quickly fill with the loose sand. It is best suited to forestry. A few areas that have a growth of juniper trees are held at \$10 to \$25 an acre.

PORTSMOUTH LOAM

The surface soil of the Portsmouth loam consists of 7 to 20 inches of dark-gray to black loam to muck, underlain by brownish-gray or bluish-gray, fairly heavy, sticky silty clay to sandy clay, with mottlings of yellow and brown in the lower part of the 3-foot section. In places the black loam or mucky loam is 3 feet deep. At the outer edge of these areas, where the adjoining soils are sandy, the surface soil may be a very dark gray loam containing considerable sand. The organic content is always high, especially in many of the larger areas where the type approaches a muck in composition. Small irregular bodies of St. Johns sand and Portsmouth sand too small to separate are included with this type.

In the vicinity of Roslin and 2 miles southwest of Power Plant along the Robeson County line are small bodies of Portsmouth sandy loam. These also have been included. Here the surface soil is a black sandy loam and the subsoil is a mottled, gray, yellow, or brown, sticky sandy clay. The cultivated areas have been drained by open ditches.

The Portsmouth loam occurs throughout the southwestern and eastern or flatwoods sections of the county, where it occupies level or depressed areas in the uplands, often elliptical or round in shape. On account of its flat surface and the compact structure of both soil and subsoil, the natural drainage is poor. This type and Portsmouth sand and St. Johns sand probably have a lower elevation than any other soil in the flatwoods section. The greater part of the type at present is in a semi-swampy condition and is locally known as "swamp" or "bay." Its wet condition has favored the growth of vegetation, through decay of which the soil in many places has accumulated large quantities of organic matter.

None of this type is under cultivation. It supports a forest growth mainly of cypress, gum, and maple, and an undergrowth of gallberry, huckleberry, and bay bushes, and other water-loving plants; some shortleaf pines grow in the better drained situations. In places juniper is a valuable growth. Most of the merchantable timber has been cut or is in the process of removal.

The greater part of the cut-over land could be reclaimed by ditching and proper draining, as nearly all the areas have sufficient fall and outlet for successful drainage. The Portsmouth loam is a cold, wet soil that requires good drainage, heavy application of lime, and deep plowing to fit it for crops. When drained and improved, it is well adapted to corn, oats, and grasses. Cabbage, onions, cucumbers, and potatoes should give good returns. This land sells from \$10 to \$30 an acre.

HYDE LOAM

The surface soil of the Hyde loam consists of a dark-brown to black loam to silt loam ranging in depth from 10 to 24 inches. The subsoil is a brownish-gray to dingy-brown or bluish sticky silty clay or plastic clay. In a few places the black surface soil is more than 3 feet deep.

Included with this type are slightly elevated spots of black or brown fine sandy loam or sandy loam underlain by a brown or drab sandy loam to sandy clay. This variation occurs about 1 mile south of Macedonia Church. Along Harrisons Creek, about a mile west of Sycamore School, the type is in a semiswampy condition and has a mucky soil. Other patches of a mucky nature are numerous. At the outer edges of areas that are bordered by sand ridges the surface soil has a sandy loam texture, probably due to wind-blown sand. The soil in well-drained areas has a mellow loamy structure, but is mucky or boggy in the undrained parts.

The Hyde loam has a total area in the county of 5,440 acres. The largest and best-drained areas lie $1\frac{1}{2}$ miles east of Cumberland Union Church, $2\frac{1}{2}$ miles west of Stedman, and 1 mile south of Macedonia Church. The largest semiswampy area lies near the head of Harrisons Creek. Other bodies occur in the southeastern part of the county.

The type is confined to depressions. The surface is prevailingly flat and the natural drainage is very poor. Before drainage was accomplished by digging open ditches the type was under water the greater part of the year. Most of the type was drained and farmed by the early settlers, but many of these old ditches have been filled in and the land has grown up to briers, broom sedge, reeds, sumac, and prickly ash. Probably not more than 25 per cent of it is now in cultivation. The rest could be drained with little difficulty. The uncultivated fields are used for pasturing cattle. The uncleared areas support a forest growth mainly of maple, gums, oaks, and hickory, with some cypress in areas where the soil approaches muck.

Corn and oats give large yields without fertilizer. On an area about 2 miles east of Cumberland Union Church, where the surface soil has a dark-brown color and contains considerable sand,

cotton is grown and with light application of fertilizer yields about 1 bale per acre. Corn, the most important crop, yields from 25 to 50 bushels per acre. Liming and the addition of potash and phosphoric acid in liberal quantities are essential for best results. Land of this type sells at \$40 to \$100 an acre.

WICKHAM SAND

The Wickham sand, to a depth of 6 to 10 inches, is a grayish-brown to brown, mellow sand to loamy sand, underlain by a reddish-yellow sand to loamy sand, which dries out to a brownish yellow. In many places the surface soil is more grayish and the subsoil is more yellow, approaching Altavista sand.

This type occurs in small areas scattered over the second bottoms of the Cape Fear River. The largest lie about 2 miles southwest of Westminster Church and about 1 mile east of Linden. The type has a gently rolling to undulating surface and occupies a position higher than any other type on the second bottoms of the Cape Fear River except the Altavista sand, which has about the same elevation. Drainage is excellent.

The Wickham sand is small in extent but is considered an all-round good soil. Probably 75 per cent is in cultivation. The forest on the rest consists chiefly of walnut, persimmon, oaks, maple, hickory, old-field pine, and some dogwood. Cotton and corn are the main crops. Soybeans, cowpeas, velvet beans, rye, melons, and all kinds of vegetables do well. Cotton yields are about the same as on the Wickham sandy loam, but the fertilizer application is heavier. Cotton receives from 600 to 800 pounds of an 8-4-3 or 8-3-3 mixture. This soil is easy to handle, and requires only light implements and work stock. It can be improved by growing and turning under more cowpeas, soybeans, and velvet beans and by liming. Land of this type sells at \$50 to \$100 an acre, depending largely upon accessibility and state of improvement.

WICKHAM SANDY LOAM

The surface soil of the Wickham sandy loam consists of a grayish-brown to brown sandy loam, 5 to 10 inches deep, passing into a brownish-yellow or reddish-yellow sandy loam extending to a depth of 8 to 14 inches. The subsoil is a yellowish-red, heavy friable sandy clay or clay which extends to a depth of 3 feet or more. Mica flakes usually occur throughout both soil and subsoil. Where this type is closely associated with the Altavista sandy loam the surface is gray and the subsoil is reddish yellow or mottled with red, yellow and gray. Small areas of Wickham sand, Altavista sand, Altavista sandy loam, narrow strips of Roanoke silt loam, Roanoke fine sandy loam, and Roanoke sandy loam, and a few very narrow strips of black to dark-brown sandy loam to loam of the Cape Fear loam type, all of which were too small to warrant separation on a map of the scale used, were included with this type.

The Wickham sandy loam has nearly level to undulating topography and occurs in irregular-shaped bodies scattered throughout the broad terrace of the Cape Fear River. The largest areas are

west of Lena, near where Rockfish Creek empties into the river and just across the river opposite Tokay. Numerous smaller areas are scattered along the Cape Fear River the entire distance across the county. The type lies at a slightly higher elevation than the Wickham fine sandy loam, and owing to its sandy loam surface soil and sandy clay subsoil it has good drainage.

This type is one of the most important of the terrace soils. Probably 90 per cent of it is under cultivation; the forest growth on the rest consists mainly of shortleaf pine, elm, cedar, and ash. Cotton and corn are the principal crops. Wheat, oats, rye, alfalfa, soybeans, velvet beans, and cowpeas give high yields. Cotton yields from one-half to 1 bale per acre. Corn yields from 20 to 40 bushels per acre. For cotton an application of 400 to 600 pounds of 8-3-3 or 8-4-4 fertilizer is generally made. Corn usually receives 300 to 400 pounds of the same kind of fertilizer and a top-dressing of sodium nitrate. A systematic rotation of crops including legumes will improve this soil. Some of the better farmers are now making use of the leguminous crops for soil improvement and also applying lime. This type sells at \$75 to \$200 an acre, depending mainly on improvements, good roads, and nearness to transportation.

WICKHAM FINE SANDY LOAM

The surface soil of the Wickham fine sandy loam consists dominantly of a light-brown or yellowish-brown fine sandy loam or loamy fine sand, 5 to 12 inches deep in the cultivated fields and from 2 to 5 inches in forested areas, underlain by a yellowish-brown or light reddish brown fine sandy loam which extends from 10 to 18 inches in depth. The subsoil is a yellowish-red, heavy, rather stiff, but friable fine sandy clay or clay. Mica flakes are present in both surface soil and subsoil. A few spots of Wickham clay loam, too small or irregular to separate on the map, are included with this type. Small bodies of Altavista fine sandy loam and Roanoke fine sandy loam are also included.

The Wickham fine sandy loam is developed on the terraces along the Cape Fear River. During extreme high water the lower part of the terrace, which usually occupies a position closer to the river, is subject to overflow. The largest area occurs on both sides of the Cape Fear River just east of Fayetteville.

The topography ranges from almost level to gently undulating. With the exception of a few low places, the type is well drained. In some places the surface soil is shallow, and when plowing is done too soon after a rain it clods or bakes. Such areas must be handled with care.

This type, though not very extensive, is important agriculturally. Probably 75 per cent of it is under cultivation. The rest is either in pastures or supports a forest growth, mainly of old-field pine, narrow-leaf oak, and gums.

Cotton and corn are the principal crops. Wheat, oats, alfalfa, and rye do well. Soybeans, cowpeas, and velvet beans are grown and give fair returns. Cotton yields one-half bale to 1½ bales per acre. Corn yields 15 to 40 bushels, wheat from 10 to 15 bushels, and oats from 25 to 40 bushels per acre. Fertilizer applications for cotton range from 300 to 600 pounds of an 8-3-3 or 8-4-3 mix-

ture. A few farmers use a home mixture of acid phosphate and cottonseed meal. From 200 to 400 pounds of the same mixture is generally used for corn, unless corn follows cotton. In this case a heavy application is used for the cotton and no fertilizer applied for the corn at planting time, but a top-dressing of about 100 pounds of nitrate of soda is used later.

The price of Wickham fine sandy loam ranges from \$50 to \$100 an acre, depending upon the location and state of improvement.

The Wickham soils were probably the first lands to be cleared and farmed in the county. This type has been used largely for cotton and as a result of clean cultivation is deficient in organic matter. The soil can be improved by using a systematic crop rotation, in which one or more of the crops are legumes.

ALTAVISTA SAND

The Altavista sand in virgin areas consists of 4 to 6 inches of dark-gray or grayish-brown, loose, medium sand, underlain by yellow, loose, incoherent sand extending to a depth of 3 feet or more. In cultivated areas this type is light gray to gray on the surface, having somewhat the appearance of Norfolk sand. In places where it is associated with the Wickham soils the surface soil is brown and subsoil is light brownish yellow.

This type occupies small patches on knolls and low ridges on the terraces along the Cape Fear River. It has about the same elevation as the Wickham sand and a little higher elevation than the other terrace soils. The topography is undulating to gently rolling, and drainage is well established.

This is an unimportant soil type and only small spots are in cultivation. The rest of the land is in forest of oak, old-field pine, and persimmon, with some gums and blackjack oak. This type is a slightly stronger and more productive soil than the Norfolk sand. It is best suited to truck crops, such as early peas, sweet corn, water-melons, and cantaloupes.

ALTAVISTA SANDY LOAM

The Altavista sandy loam consists of an upper layer of gray to yellowish-gray sandy loam, 5 to 9 inches thick, passing into a pale-yellow heavy sandy loam to sandy clay, which extends to a depth of 12 to 18 inches and then into a yellow, heavy but friable sandy clay, mottled with gray and yellowish red in the lower part. In places the surface is a mouse gray and the subsoil is mottled gray, yellow, and reddish brown. Some patches of Roanoke sandy loam and Roanoke fine sandy loam are included with this type.

This type occupies small areas scattered through the terraces along the Cape Fear River. It has slightly higher elevation than the Roanoke soils. The topography ranges from nearly flat or undulating to gently rolling. In most places drainage is good.

Although this type is of small extent, it is considered an important soil. Probably 80 per cent of it is under cultivation. On the uncleared areas the vegetation consists of old-field pine, sweetgum, oak, hickory, and dogwood. Cotton and corn are the principal crops; soybeans, velvet beans, cowpeas, oats, alfalfa, crimson clover, and

vegetables are grown successfully. Cotton and corn yields are just a little lower than on the Wickham sandy loam. The same kind of fertilizer and the same rate per acre is used on this type as on the Wickham sandy loam.

ALTAVISTA FINE SANDY LOAM

The Altavista fine sandy loam consists of 6 to 9 inches of gray to grayish-brown, mellow, fine sandy loam, passing into a pale-yellow, friable fine sandy clay which extends to a depth of 15 to 22 inches, and grades into yellow, heavy fine sandy clay to clay, frequently becoming mottled yellow, gray, and brown in the lower part of the 3-foot section. Where this type is associated with the Wickham fine sandy loam the subsoil is considerably mottled with yellowish-red and yellow; and in the zone of contact with the Roanoke soils the subsoil has more gray in it and is heavier than usual. Small areas have been included with some of the other terrace soils.

This type occurs on the second bottoms of the Cape Fear River. It has a flat to undulating topography, and is generally well drained. It is of minor importance owing to its small extent.

Cotton and corn are the main crops, although soybeans, cowpeas, crimson clover, vetch, oats, and wheat do well. Truck crops and vegetables are grown. Cotton yields from one-fourth to three-fourths bale per acre, corn from 15 to 35 bushels. The fertilization for the different crops is the same as for the Wickham soils.

ROANOKE SANDY LOAM

The surface soil of the Roanoke sandy loam is a gray to dark-gray, heavy sandy loam 6 to 10 inches deep. The subsoil is a mottled yellow, steel-gray, and red, heavy, plastic sandy clay. As mapped in this county the surface has a darker color than any of the other Roanoke types. It includes a few spots of Roanoke fine sandy loam and Roanoke silt loam and small strips of dark-gray to nearly black sandy loam, which would have been separated as Cape Fear sandy loam if they had been of sufficient size to show on the map.

One spot of gravelly sandy loam included with this type is indicated on the map by gravel symbols. This area is 4 miles east of Fayetteville. The material is being used for surfacing roads.

The Roanoke sandy loam occurs in scattered areas through the central part of the county. It lies on the broad terraces along the Cape Fear River. The largest developments are in the vicinity of Carvers Creek and Reaves and 3 miles east of Fayetteville along the Wilmington branch of the Atlantic Coast Line Railroad. Numerous smaller areas occur on the river terrace from the Harnett County line to the Bladen County line.

Drainage is not very well established, and ditching is necessary to fit the soil for agriculture. This type is of small extent and unimportant, although good crops of corn, cotton, and oats are obtained on some of the better drained areas. Only a small proportion of the type, probably 15 per cent, is under cultivation. The rest is either in mixed forest similar to that of the other terrace soils or in pasture. Corn yields from 10 to 30 bushels, cotton one-fourth to one-half

bale, and oats from 20 to 35 bushels per acre. Fertilizer practices are the same as on most all the other soils. This type could be improved by draining, liming, deeper plowing, and by growing legumes in a crop rotation.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Roanoke sandy loam:

Mechanical analyses of Roanoke sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
235473	Soil, 0 to 9 inches-----	6.6	21.4	13.0	19.5	5.0	16.6	17.9
235474	Subsoil, 9 to 36 inches.	7.5	28.8	12.0	11.6	1.2	10.2	28.9

ROANOKE FINE SANDY LOAM

The Roanoke fine sandy loam consists of 5 to 8 inches of gray fine sandy loam underlain by a light yellowish gray, heavy fine sandy loam to fine sandy clay, extending to a depth of 10 to 14 inches. The subsoil is a mottled yellowish-brown, gray, and yellow, sticky, plastic fine sandy clay to clay extending to a depth of 3 feet or more. In some places the surface is dark gray and the subsoil is a steel-gray, mottled brown, plastic fine sandy clay. In other places, where it is closely associated with the Roanoke silt loam, the surface soil is finer than usual.

This type occurs in small scattered bodies in the second bottoms along the Cape Fear River. The largest areas are in the vicinity of Beard, and about 1 mile south of Johnson Church. The land is prevailingly flat but lies slightly higher than the Roanoke silt loam and slightly lower than the Roanoke sandy loam. It is not well drained, but with the aid of a few open ditches it can be farmed.

This is not an important soil and probably less than 20 per cent of it is being cultivated. Corn, cotton, and oats are the chief crops. This is a cold soil and for that reason is better adapted to corn, oats, and soybeans than to cotton. Corn yields from 10 to 30 bushels per acre, cotton one-fourth to one-half bale, and oats 30 to 40 bushels. From 300 to 500 pounds of an 8-3-3 or 8-4-3 mixture of fertilizer is used for corn, and 500 to 700 pounds of the same mixture for cotton. The type sells at \$10 to \$50 an acre, depending on its location and improvements.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Roanoke fine sandy loam:

Mechanical analyses of Roanoke fine sandy loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
235467	Soil, 0 to 7 inches-----	0.6	4.9	6.4	25.7	25.9	27.5	8.9
235468	Subsurface, 7 to 12 inches.	1.2	4.4	5.8	25.8	26.5	28.6	7.7
235469	Subsoil, 12 to 36 inches	.6	23.6	4.2	19.2	20.8	23.6	7.9

ROANOKE SILT LOAM

The surface soil of the Roanoke silt loam is prevailingly a light-gray to gray, compact, heavy silt loam, 3 to 6 inches deep, passing into a yellow and gray, mottled with rusty-brown, heavy silty clay loam to silty clay, which extends to about 10 inches in depth. The subsoil is a gray and yellow, mottled with red, heavy, plastic silty clay to clay. In many places the surface soil is shallow and the tough, plastic subsoil, mottled yellow, brown, gray, and red, begins at 4 to 6 inches. In other places the surface soil is a light-gray to steel-gray silty clay loam to a depth of 8 to 12 inches, underlain by a steel-gray, mottled with yellow, heavy, plastic clay. Included with the type are a few patches of gray to pale yellowish gray silt loam to very fine sandy loam, underlain by a yellowish heavy silty clay, becoming mottled with red at about 20 to 30 inches. These spots occur at a slightly higher elevation than the typical Roanoke silt loam, and a few patches are being farmed. Many slightly depressed areas throughout the type are wet most of the year.

The Roanoke silt loam has the largest development of the terrace or second-bottom soils in the county. It occurs in areas ranging from narrow strips to large bodies containing several square miles. The largest of these is an irregular shaped area extending from a point about 1 mile south of Linden to Reaves on the Norfolk Southern Railroad. On the opposite side of the Cape Fear River there are several fair-sized areas.

The topography is level or in small areas slightly depressed. The land is poorly drained, water standing on the surface in rainy seasons. None of this typical Roanoke silt loam is under cultivation. Where it joins the Wickham or Altavista types narrow strips in a few places are farmed. The forest growth consists mainly of oaks, maple, gum, pine, elm, hickory, dogwood, and holly. Much of this type has a stand of reeds and coarse grass that affords good pasturage for cattle. Apparently some of this soil was at one time drained and farmed, and it is said that these areas produced fair yields of corn and oats.

The soil is difficult to handle, because the surface soil in most places is shallow and the subsoil is compact and heavy. The plastic, impervious structure of the subsoil material also makes it difficult to drain the areas properly. With open ditches at frequent intervals, deeper plowing, and the addition of large quantities of organic matter this soil probably could be made to produce fair yields of corn, oats, and soybeans. Land values range from \$10 to \$25 an acre, depending on location, timber growth, and nearness to towns. Near Slocumb the clay subsoil is being used for the manufacture of brick.

The results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Roanoke silt loam are given in the following table:

Mechanical analyses of Roanoke silt loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
235475	Soil, 0 to 4 inches-----	0.6	0.9	0.5	11.1	11.6	55.4	19.9
235476	Subsurface, 4 to 9 inches.	.2	.6	.4	8.8	15.4	56.6	17.9
235477	Subsoil, 9 to 36 inches-	.0	.2	.0	1.3	9.4	46.4	42.6

CAPE FEAR LOAM

The surface soil of the Cape Fear loam, ranging in depth from 12 to 30 inches, consists of a very dark gray to black loam. This is underlain by a steel-gray or light-gray to light grayish brown heavy plastic clay which extends to 3 feet or more. In places the lower subsoil has a mottled gray and yellowish-brown or ochreous-yellow color. The subsoil is lacking in places, the black surface soil continuing to a depth of more than 3 feet.

Where the type joins the sandy terrace soils the surface is a dark-gray sandy loam, probably owing to an admixture of wind-blown sand. If these areas had been larger they would have been mapped as Cape Fear sandy loam. Small low ridges of dark-gray surface soil and light-gray sand to sandy loam subsoil occur in a few places. These are locally known as "herring-bone ridges." Some of the Cape Fear loam in poorly drained places resembles muck or peat at the surface. During a dry spell in 1922 the surface layer of an area about 3 miles northwest of Sunnyside School was burned off to a depth of 1 or 2 feet.

The Cape Fear loam is developed on the terraces of the Cape Fear River, usually along or near the uplands. It is not an extensive type. Three of the largest areas lie between Wade and Beard, 2 miles northwest of Sunnyside School, and 1 mile east of Jacks Mill.

The topography is generally flat and the drainage poor. In order to bring areas under cultivation it has been necessary to dig canals and ditches.

Large areas of this type have been cleared and are used for pasture. Practically all the area lying about 1 mile east of Jacks Mill has been cleared and affords good grazing. Some farmers buy cattle and pasture them over winter on this soil. The reeds furnish pasture through the winter and grasses and shrubs in the summer. Very little of the original timber growth remains. It consisted mainly of gums, poplar, and cypress, with an undergrowth of briers, reeds, and water-loving shrubs.

Not more than one-fifth of the type is under cultivation. Corn, potatoes, and oats are at present the principal crops. Cotton, soybeans, and vegetables are grown to some extent. This is considered the most productive soil in the county for corn and potatoes. Corn yields from 30 to 80 bushels per acre without the use of fertilizer. Potatoes yield from 100 to 300 bushels per acre, and oats from 25 to 50 bushels. Celery, cabbage, onions, and collards would probably give good returns.

The Cape Fear loam sells at \$30 to \$100 an acre, depending mostly on drainage, whether the land is located near a canal, and the condition of improvements.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Cape Fear loam:

Mechanical analyses of Cape Fear loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
235431	Soil 0 to 14 inches----	<i>Per cent</i> 3.6	<i>Per cent</i> 6.8	<i>Per cent</i> 3.1	<i>Per cent</i> 14.1	<i>Per cent</i> 17.5	<i>Per cent</i> 32.3	<i>Per cent</i> 22.7
235432	Subsoil, 14 to 36 inches	.6	4.6	3.2	8.6	10.6	40.5	31.8

KALMIA SAND

The Kalmia sand is a gray, loose, medium sand to fine sand, with a depth of 4 to 9 inches, underlain by a pale-yellow incoherent sand extending to a depth of 3 feet or more. In some flat places the surface soil ranges in color to dark-gray and in texture sand or fine sand to loamy sand. The lower subsoil in some places also becomes loamy and mottled gray and yellow.

Small areas of Kalmia sand are mapped along Little River, South River, and Rockfish Creek. The largest area lies southeast of Hope Mills. The type occurs on second bottoms deposited by streams of the Coastal Plain when they flowed at higher levels than at present. The surface is gently rolling or undulating to nearly level, and drainage for the most part is excellent. A few low spots are wet.

This is a small and unimportant soil type. Only a little of it is under cultivation; the rest supports a forest growth mainly of blackjack oak and shortleaf pine. The crop yields are generally low, but in some places under good management cotton yields from one-third to two-thirds bale per acre, averaging about one-half bale. Corn is grown for home use and truck crops do fairly well. This soil is easily tilled with light work stock and implements. Heavy applications of a high-grade fertilizer must be used in order to obtain large yields.

KALMIA SANDY LOAM

The surface soil of the Kalmia sandy loam consists of 2 to 5 inches of gray to dark-gray sandy loam in the wooded areas, or 6 to 8 inches of gray to light-gray sandy loam in cultivated fields, underlain by a pale-yellow sandy loam which extends to a depth of about 15 inches. The subsoil is a yellow, friable, fine sandy clay, slightly mottled with gray in the lower part of the 3-foot section. Small areas of the Kalmia fine sandy loam and Myatt sandy loam were included with this type.

Along South River, south of Rhodes Mill and about 1½ miles east of Oak Grove School, occur two areas that have from 10 to 30 per cent of white rounded quartz gravel scattered over the surface and through the soil mass. Near Rhodes Mill the material is being dug out and used for surfacing highways. These gravel spots are indicated on the map by gravel symbols.

The largest areas of Kalmia sandy loam occur along South River, Mingo Swamp, Little Rockfish and Rockfish Creeks, and Little River. The type occupies second bottoms or terraces and consists of material which apparently was deposited on former flood plains at a time when the stream overflows reached higher levels than at present. It is no longer overflowed during ordinary rains. Drainage is usually good to fair, except in a few included spots of Myatt sandy loam.

Owing to its small extent, this type is not important. About half of it is under cultivation, cotton and corn being the principal crops. Cotton yields from one-third to 1 bale per acre, with an acreage application of 500 to 800 pounds of an 8-3-3 or 8-4-3 mixture. Corn receives about 200 to 400 pounds of the same mixture and yields from 15 to 30 bushels. Oats, wheat, rye, crimson clover, soybeans, in fact all crops suited to the upland sections of the county, do well on this soil.

With deeper plowing and the addition of plenty of organic matter by growing cowpeas, soybeans, crimson clover, and rye good yields are maintained with moderate fertilization. By ditching and draining the flatter more poorly drained areas, all of this type can be used for general farming.

KALMIA FINE SANDY LOAM

The surface soil of the Kalmia fine sandy loam is a gray to brownish-gray mellow fine sandy loam, 3 to 6 inches deep, passing into a pale-yellow fine sandy loam which extends to a depth of 10 to 15 inches. The subsoil is a bright-yellow friable fine sandy clay extending 3 feet or more. Locally the lower part of the 3-foot section is slightly mottled with reddish yellow in better drained areas and in some other places with gray. In poorly drained areas the surface soil is dark gray and the subsoil is a mottled yellow and gray rather heavy fine sandy clay.

The Kalmia fine sandy loam has a small extent, less than 3,000 acres. The largest areas are along the Little River, north and west of Manchester, near McCormack Bridge, and at Hope Mills. The topography is almost level to gently undulating. Drainage is good except in a few flat places. Some of the lowest parts are subject to overflow during extremely high floods.

This type is unimportant owing to its small extent. About one-fifth of it is under cultivation. The forest growth consists mainly of old-field pine, sycamore, sweetgum, persimmon, walnut, dogwood, holly, and ash. Cotton and corn are the main crops. Oats, wheat, cowpeas, soybeans, and all kinds of truck crops are grown with good results. In the vicinity of Hope Mills cotton yields from one-half to 1 bale per acre, and corn from 20 to 40 bushels. Other crops give fair returns.

By growing and turning under soybeans, cowpeas, velvet beans, crimson clover, and rye, applying lime, and rotating the crops this type of soil could be built up to high state of productiveness.

CAHABA SANDY LOAM

The surface soil of the Cahaba sandy loam to a depth of 4 to 8 inches is a gray to light-brown medium sandy loam. Below this is

a layer of yellowish-brown to reddish-yellow sandy loam extending to depths of 9 to 15 inches. The subsoil is a yellowish-red friable sandy clay, which extends to a depth of 3 feet or more. The type shows some variation in color and texture. In places the surface is dark gray and the subsoil is mottled yellow and reddish yellow; in other places the texture of the soil is a fine sandy loam. Spots of Kalmia sandy loam, Kalmia fine sandy loam, and Kalmia sand are included with this type.

The Cahaba sandy loam occurs in small areas along Little River. The largest lie east of Manchester and just west of Linden. It is a second-bottom soil with a gently rolling to undulating topography and good drainage.

There are only 2 square miles of this soil in the county. It is an excellent soil and about 70 to 80 per cent of it is under cultivation. Cotton is the principal crop. Corn, wheat, cowpeas, soybeans, and many other crops do well. Cotton yields from one-half bale to 1½ bales per acre, averaging about 1 bale. Corn yields 20 to 40 bushels, and wheat 8 to 15 bushels per acre. Methods of handling and fertilizer applications are the same as on the Kalmia sandy loam.

MYATT SANDY LOAM

Myatt sandy loam as mapped in this county has a bluish-gray to dark-gray heavy sandy loam surface soil 8 to 14 inches deep. The subsoil is a steel-gray to mottled gray and yellow, sticky, rather plastic sandy clay, with some rusty-brown splotches, which extends to a depth of 3 feet or more. In places a few rounded quartz gravel fragments are scattered over the surface and mixed with the soil mass, and in some spots the surface soil is a coarse sandy loam over a sticky coarse sandy clay subsoil. Included with this type are patches of Okenee loam and bars of Kalmia sand too small to warrant separation.

The Myatt sandy loam, one of the smallest types in the county, occurs in a few areas on the terrace along Little River. The largest area lies northeast of Manchester. The type occupies low, flat, or slightly depressed situations closely associated with the Cahaba and Kalmia soils. It is poorly drained and requires artificial drainage before it is suitable for agriculture. In its original state the soil probably remained in a saturated condition most of the year and was considered of low agricultural value. The greater part of the Myatt sandy loam in this county has been properly drained and about 80 per cent of it is being cultivated. Fair yields of corn, oats, and cotton are produced, and wheat, cowpeas, soybeans, velvet beans, and rye are grown very successfully. The original forest growth consisted mostly of water oak, maple, gum, ash, and pine.

A large part of this type of soil is included in one farm, and this land has produced as high as 80 bushels of corn, 65 bushels of oats, 1½ bales of cotton, and 5 tons of millet and cowpea hay per acre. In one year the same piece of land produced 65 bushels of oats and 40 bushels of corn per acre. Other crops are also grown at the rate of two crops per year on this soil. About 800 pounds per acre of 8-4-3 fertilizer is used for cotton, applied at the time of planting. Corn planted the year following the cotton is not fertilized at time of planting, but 100 pounds of nitrate of soda is applied later as a

top-dressing. A very promising experiment in crop rotation, which is described in the chapter on agriculture, is being conducted on this farm on land of the Myatt sandy loam and the associated Cahaba sandy loam.

OKENEE LOAM

The surface soil of the Okenee loam is a very dark gray to black loam, ranging in depth from 8 to 18 inches. The subsoil is a drab, gray, and yellow fairly tough, but friable fine sandy clay to heavy, sticky sandy clay. In some places the lower subsoil is slightly plastic. As mapped in this county, the surface is somewhat mucky, owing to a high content of organic matter accumulated from the dense growth of water-loving plants. In a few places the black loam extends to a depth of 3 feet or more. On slight elevations within this type the soil is a dark-gray fine sandy loam passing into a gray and yellow friable fine sandy clay at a depth of 5 to 10 inches.

Included with this type are a few strips of Johnston loam. This soil differs from the Okenee loam in that it occurs in the first bottoms and is subject to overflow. It is found along Harrisons Creek 4 miles south of Cedar Creek and in a few other localities. None of it is farmed, but it would produce large yields of corn if drained and cleared.

The Okenee loam occupies only a few small areas in this county. The most important are southeast of Hope Mills on the south side of Rockfish Creek, along South River about 3 miles northeast of Beaverdam Church, and a small body along Little River west of Manchester.

The type occurs on second bottoms of streams in the Coastal Plain, usually next to the sand hills or upland and farthest from the stream. The topography is flat or slightly depressed and drainage is poorly established, the land remaining wet the greater part of the year.

In its present condition this type is not of agricultural importance. None of it is under cultivation and about all the timber has been cut off. The forest growth consists mainly of pine, maple, gum, and cypress, and an undergrowth of bamboo brier, gallberry, and other water-loving vegetation. If properly drained and limed, the Okenee loam would be adapted to corn, oats, cabbage, onions, and probably celery. The type is generally sold with adjacent soils.

CONGAREE SILT LOAM

The surface soil of the Congaree silt loam consists of 6 to 15 inches of brown heavy silt loam. The subsoil is a light-brown to reddish-brown, compact, friable silty clay loam.

The Congaree silt loam occurs as narrow strips in the first bottoms of the Cape Fear River. The surface is prevailingly flat, with a gentle slope toward the stream. The type is subject to frequent overflows. Between overflows the drainage is fairly good, except in some depressed areas near the upland.

This type is among the smallest in the county. About 5 per cent of it is in cultivation, the remainder being either in pasture or in forest consisting of sycamore, water oak, sweetgum, elm, old-

field pine, ash, and some cypress. Corn, hay, and oats constitute the principal crops. On fields properly drained large yields of corn and oats are obtained without the use of fertilizer.

In some parts of the State, where this type is more extensive, corn yields 40 to 80 bushels per acre, oats 30 to 50 bushels, and other crops give good yields. In Cumberland County this type is best suited to pasture, because the overflows of the river are too frequent to permit the growing of many crops successfully.

CHASTAIN LOAM

The Chastain loam consists of a gray or dark-gray to nearly black loam to silt loam, 4 to 7 inches deep, passing into a rather heavy drab silty clay or sandy clay, which grades at a depth of 10 to 16 inches into a steel-gray or drab plastic clay mottled with yellow and rusty brown. In some places red mottlings are found in the lower part of the 3-foot section.

This type is mapped only along South River and Mingo Swamp, in the eastern side of the county. It is subject to frequent overflows and the greater part of it remains in a swampy or semiswampy condition most of the year.

One area of 50 or 75 acres has been cleared along South River and is in pasture. None of the type is under cultivation, but much of it is used for pasturing hogs and cattle. If drained and limed, it would probably give fair yields of corn and oats. Nearly all of it supports a dense growth of sweetgum, tupelo gum, pines, cypress, and ash.

SWAMP

Swamp, as mapped in Cumberland County, represents areas along the stream courses which are subject to overflow and are saturated most of the time. The soil material varies considerably in texture, color, and structure. The color of the surface soil ranges from gray and dark gray to black, and the texture ranges from coarse sand to loam and silt loam. The subsoil is usually heavier than the surface soil and may be a sandy clay, silty clay, or clay, with a drab, mottled yellow, gray, or brown color. In places the subsoil consists of beds of medium sand, coarse sand, and fine gravel, with very little organic matter. In some of the broad and flat areas the surface soil contains much organic matter and is almost mucky, and in a few places the soil is a black mucky loam extending to a depth of 3 feet or more.

Swamp occurs in narrow strips along nearly every creek and branch in the county. The largest are along Harrisons, Turnbull, and Beaverdam Creeks, South River, and Browns Swamp, in the southern and eastern parts of the county. The land is covered with water the greater part of the year and none of it is under cultivation. It supports a forest growth consisting mostly of ash, gum, pine, holly, maple, and cypress, and an undergrowth of gallberry bushes, bay bushes, and other water-loving plants.

If some of the large swamps, like along Harrisons, Turnbull, and Beaverdam Creeks and Brown Swamp, were drained and cleared they would probably prove to be good farming land. Corn should do well. Swamp in this county is best suited to forestry.

SUMMARY

Cumberland County lies in the south-central part of North Carolina. It has an area of 647 square miles, or 414,080 acres. About 50 square miles of this is included in the United States Artillery Reservation.

The county embraces three distinct topographic and soil regions, namely, sand hills, flatwoods, and bottoms. The sand-hill section is confined mainly to the northern and northwestern part of the county. In this region the soils are prevailing sands or light sandy loams, and their farming value is low. The flatwoods region occupies the southern and eastern parts of the county and embraces some of the best developed and most productive soils, including good upland sandy loams. The bottom lands are developed mainly through the central part of the county, in a strip from 1 mile to 6 miles wide along the Cape Fear River. Much of this land has been under cultivation since the early settlement of the county and good crops are still obtained upon these soils.

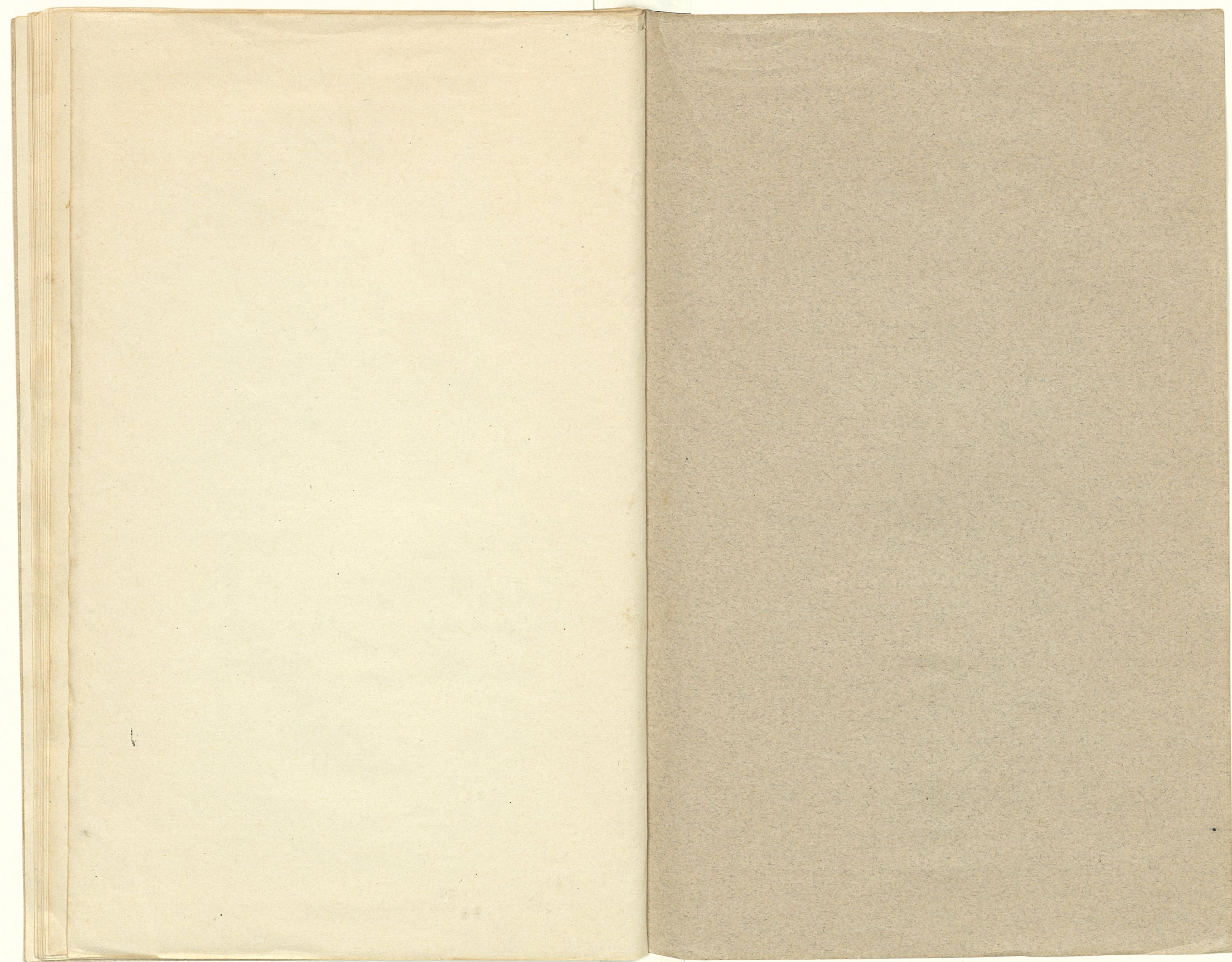
The climate of Cumberland County is mild, with a long growing season and ample rainfall well distributed to meet the requirements of various crops.

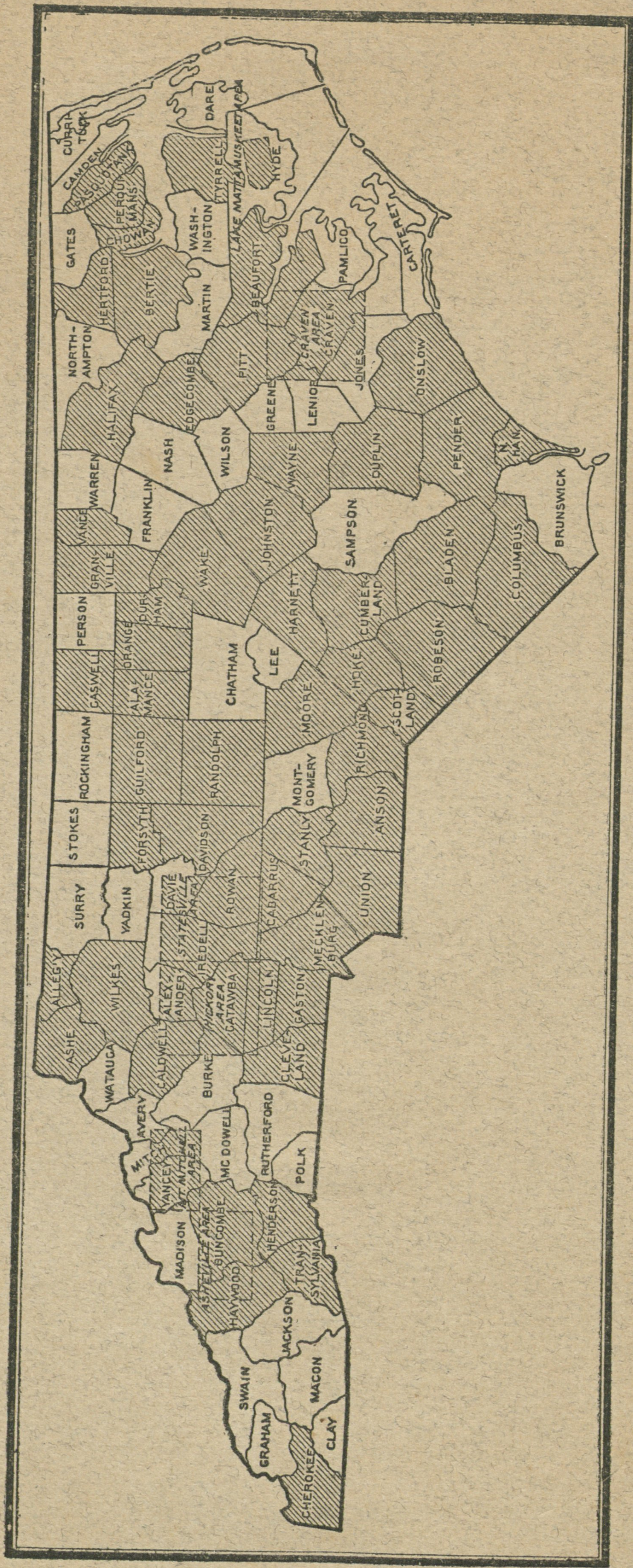
Agriculture is the chief industry of the county. The principal crops are cotton, corn, and oats, with some peaches, truck crops, tobacco, and peanuts.

The soils of this county have a very wide range in texture and structure and are adapted to a varied list of crops. The sand-hill section, once considered practically worthless for agriculture, has come into favor as a peach region. Dewberries also do well in this section. The sandy loams of the uplands and the second bottoms constitute the best all-around agricultural soils of the county. Such soils as the Hoffman sandy loam, Leon, St. Lucie, St. Johns, Plummer, and Portsmouth sands, and Swamp are better suited to forestry than to cultivation.

There is a large area of unoccupied land in this county. The relatively low prices at which this can be obtained, together with the excellent transportation facilities, good roads, and other natural advantages, offer many opportunities for development.

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Areas surveyed in North Carolina, shown by shading