

# SOIL SURVEY OF ORANGE COUNTY, NORTH CAROLINA.

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## DESCRIPTION OF THE AREA.

Orange County is situated in the central-northern part of North Carolina, in the second tier of counties from the Virginia line. Its length north and south is  $25\frac{1}{2}$  miles, and its average width  $15\frac{1}{2}$  miles. It has an area of 400 square miles, or 256,000 acres.

The prevailing topography is that of a gently rolling upland or peneplain, with an elevation varying from 500 to 600 feet over the greater part of the county where the underlying rocks are hard, and from 250 to 400 feet in the southeastern corner, underlain by the Triassic rocks. This Triassic area, being of softer and more easily eroded materials, has been greatly lowered since the uplift of the peneplain.<sup>1</sup> The elevation at Hillsboro is 548 feet. Higher elevations are encountered on Mount Collier, and Crawford, Balls, Blackwood, Couch, and Occoneechee Mountains. The highest of these, Occoneechee Mountain, has an elevation of 830 feet above sea level. These are all residual hills, or monadnocks, except Mount Collier,<sup>2</sup> which is a volcanic plug exposed by the eroding away of the materials of the cone.

Orange County is situated in the eastern part of the Piedmont Plateau, and its surface slopes from the northwest toward the east and southeast. The county includes three fairly distinct topographic divisions, which conform with the character of the underlying rock formations and the results of stream action, the latter being a powerful factor in producing the uneven surface features. These subdivisions are recognized as follows: (1) A broad belt of gently rolling to strongly rolling country occupying the greater part of the county, and underlain by slate; (2) rolling, broken, and steep areas occurring as belts in the northwestern and southern parts, and in



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

<sup>1</sup> Statement of Prof. Collier Cobb.

<sup>2</sup> The volcanic origin of this mountain was pointed out by Prof. Cobb in 1892.

numerous smaller areas throughout the county, representing the areas underlain by granite; and (3) a small area of low-lying, undulating to gently rolling country, underlain by Triassic rocks, occurring in the extreme southeast corner of the county and known as The Arm of the Sea. With the exception of the mountains and some of the steeper slopes bordering the streams, practically all of Orange County lies favorably for agricultural occupation.

The bottom lands in Orange County are generally narrow and in-extensive, especially through the granite and slate belts. Even along the larger streams, such as the Eno River, they occur as narrow, interrupted areas, usually in the bends of the channel or at points of junction with tributary streams. The bottom lands through the Triassic belt in the southeastern corner of the county (the softest and most easily weathered rock material in the county) are moderately extensive, but even these are in many places cut off by dikes of harder rocks. The bottoms are all subject to occasional overflow.

The county is thoroughly dissected by streams, and there are no large upland areas without natural drainage outlets. While there are flat areas through the uplands and the wider bottoms that are poorly drained, over the greater part of the county the surface water flows off so rapidly as to cause serious erosion. Practically all the streams in the county are perennial, except the smaller streams in the Triassic belt, which are occasionally dry during the summer months. On the slopes of the ridges between the creeks and branches the surface water flows off through depressions, gullies, and draws. The streams generally have rapid currents.

The regional drainage of Orange County is to the east and southeast. The northeastern part of the county is drained by the Eno and Little Rivers and their tributaries, the eastern and southeastern parts by New Hope and Morgan Creeks, and the western and southwestern parts by Cane Creek and Haw River.

There is sufficient fall on most of the streams for the development of water power to run grist and flour mills. Such mills are now in operation on a number of streams, and in the early days they were quite numerous.

Orange County was formed in 1752, but its boundaries have been changed several times since then. Hillsboro, the first county seat, was laid off in 1754. The early settlers in this region were largely Scotch-Irish and English, together with immigrants from the older American colonies to the east and northeast. According to the census, the population of Orange County was 14,948 in 1890, 14,690

in 1900, and 15,064 in 1910. The white population amounts to 67.3 per cent of the total. The population averaged 38.6 persons to the square mile in 1910. There are practically no foreign-born persons in the county.

Hillsboro, Chapel Hill, and Carrboro, having a population of 857, 1,149, and 1,000, respectively, in 1910, are the only incorporated towns. Mebane, a town lying principally in Alamance County, extends slightly over the western boundary line. There are a number of small railroad towns and trading points.<sup>3</sup>

The principal industry of Orange County, aside from agriculture, is manufacturing. Extensive cotton mills and knitting mills are operated at Hillsboro and Carrboro. There are flour mills at Hillsboro, Efland, and Carrboro, and numerous small mills for grinding flour and meal are operated throughout the county. The lumbering industry is also important. Orange County is locally well known as a source of hardwood lumber. In recent years, with the prevailing high prices, the cutting of the second-growth pine lumber has become profitable, and there are numerous small sawmills in operation throughout the county. A considerable amount of red cedar also is cut and shipped for the manufacture of cedar chests. Iron, mica, gold, copper, sandstone, whetstone, and pink granite have all been found in the county, but not in paying quantities. Brown sandstone has been quarried in the southeastern part of the county and used to some extent for building purposes.

Railroad facilities are furnished by the Goldsboro-Asheville Division of the Southern Railway, which crosses the center of the county in a general east and west direction, passing through Hillsboro and Efland. A branch line of the Southern Railway connects Chapel Hill and Carrboro with this main line at University.

There are a number of graded and surfaced roads radiating from Hillsboro. A surfaced road from Durham to Burlington traverses the southern part of the county in a general east and west direction, passing through Chapel Hill, Carrboro, White Cross, and Oaks. Owing to the heavy character of the greater part of the soils of the county, many of the roads become very heavy in winter, and in general the road system might be greatly improved.

There are numerous educational institutions in Orange County. The State University is located at Chapel Hill. There are two State high schools in the county, at Hillsboro and Chapel Hill. In addition, there are numerous grammar schools throughout the county.

Most sections of the county are reached by rural mail routes and telephone lines.

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<sup>3</sup> Since this report was written the preliminary announcement of the population of Orange County and its civil divisions in 1920 has been issued by the Bureau of the Census, as follows: Orange County, 17,895; rural, 17,895; Chapel Hill, 1,483; Hillsboro, 1,180; Carrboro, 1,129; Mebane, total 1,351, part in Orange County, 117.

## CLIMATE.

The following climatological table is compiled from records kept by the Weather Bureau station at Chapel Hill:

*Normal monthly, seasonal, and annual temperature and precipitation at Chapel Hill.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1892).	Total amount for the wettest year (1901).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	42.2	79	6	3.81	2.77	4.56
January.....	39.8	80	— 1	3.82	6.22	2.39
February.....	43.0	77	— 6	4.12	3.22	1.52
Winter.....	41.7	80	— 6	11.75	12.21	8.47
March.....	49.2	92	13	4.51	2.74	3.72
April.....	58.8	97	26	3.85	3.15	5.89
May.....	68.0	98	29	4.52	3.39	11.38
Spring.....	58.7	98	13	12.88	9.28	20.99
June.....	75.6	104	41	3.75	6.12	5.69
July.....	78.7	107	52	4.88	3.72	6.12
August.....	77.0	105	52	5.25	.82	11.25
Summer.....	77.1	107	41	13.88	10.66	23.06
September.....	71.5	102	35	3.54	1.97	4.75
October.....	59.9	93	26	3.25	.27	2.13
November.....	49.9	85	13	2.78	4.35	1.94
Fall.....	60.4	102	13	9.57	6.59	8.82
Year.....	59.5	107	6	48.08	38.74	61.34

The mean annual rainfall of 48.08 inches is well distributed throughout the growing season. There is no record of a complete crop failure from dry weather, although corn, small grains, and hay crops are occasionally injured locally by drought.

The mean annual temperature is 59.5° F. The weather in general is mild, although subject to sudden changes. The winters are usually characterized by periods of several days of moderately cool weather, alternating with a like period during which lower temperatures prevail. The depth of freezing is shallow, but freezes are of sufficient frequency to have a beneficial effect upon fall-plowed land. Zero weather is of rare occurrence.

The dates of the latest recorded killing frost in the spring and of the earliest in the fall are, respectively, April 24 and October 1.

The average dates of the last killing frost in the spring and of the first in the fall are, respectively, April 8 and October 30. The length of the average growing season is about 200 days. This is ample for the maturing of all the general farm crops, and as a rule two crops, such as corn, cowpeas, or soy beans after a small grain, can be grown in one season. The mild winters are favorable to the growth of winter oats, winter wheat, clovers, alfalfa, such winter cover crops as crimson clover, rye, and vetch, and the hardier vegetables. Breaking of land may often be carried on until Christmas. The mild open winters, requiring only slight shelter for farm animals and suited to the growth of such winter grazing crops as rye, wheat, and oats, favor the raising of live stock.

#### AGRICULTURE.

Agriculture has been the leading industry of Orange County since its first settlement. The early settlers, locating on the fertile redlands along the larger streams, grew corn, wheat, potatoes, and other vegetables. Beef cattle, hogs, and sheep were raised as the main source of meat and wool. Deer, turkeys, and other wild game were abundant and frequently furnished a large proportion of the meat supply. Indigo, hemp, and flax were crops of importance at an early date. As the need for money grew, and with the invention of the cotton gin, cotton and tobacco became important crops.

A plantation system of farming was gradually developed, large areas of forest land being cleared and put in cultivation. Little attention was given to the maintenance of soil fertility—as judged by present-day methods—to terracing, deep plowing, or the growing of legumes and winter cover crops. Land was plentiful, and when a field deteriorated below the point of profitable productiveness it was “turned out” and fresh land was taken into cultivation. Through all parts of the county there are to be found tracts of land supporting second-growth timber which were at one time in cultivation, as shown by the still distinguishable lines of old corn and cotton beds.

Each plantation was practically a self-sustaining economic unit. All the meat, milk, butter, and feed consumed were produced on the farm, and from the home-grown cotton and wool practically all the clothing was made. Leather was tanned for the making of harness and shoes, and most of the farm implements were homemade. Every cotton farmer had his screw compress and gin, and meal and flour were ground by water-power mills at home or on neighboring streams.

Through the loss of labor and capital attendant upon the Civil War the plantations in most cases were broken up, and frequently the greater part of the land was sold to liquidate the debts of war.

In 1880, according to the census, the average size of the farms was 115.5 acres, with an average of 36.1 acres of improved land per farm. The average farmer was not able to have efficient implements and work stock, and the farm work was done in a superficial way. This fact, together with the generally low prices of farm products, was discouraging to those who desired the agricultural development of the county. The more liberal prices of farm products and the general introduction of the soil-improving legumes have resulted in an improvement in agricultural conditions during the last few years.

Agriculture in Orange County at present varies widely in the different sections, owing largely to the varying soil conditions. Through the sandy lands of the northwestern corner of the county tobacco is the leading crop, although most farmers produce enough food crops for the family needs and for the work stock. In the southern part of the county cotton is the principal cash crop, with scattered patches of tobacco. Here again the food crops necessary for home use are grown. Through the central part, composed largely of the red lands, general farming prevails. Here and there, on small local areas of sandy land or gray gravelly land, tobacco is grown, and on some areas cotton, but general farming is the prevailing type of agriculture. Corn and small grains, clover and other legumes are grown in sufficient quantity for home use, with a small surplus for market. Fruits and vegetables are often sold. Milk, butter, poultry and eggs, and some beef are produced, with a small surplus for market.

Corn is the leading crop. According to the census, there were 22,214 acres in corn, with a total production of 339,069 bushels, in 1909. This is an average production of only 15 bushels per acre for a county in which 1 acre has produced over 100 bushels under boys' corn club management. The corn crop is used for feeding work stock and hogs, and for making meal for table use. In harvesting the top of the stalk is usually cut off and the blades stripped from the remaining part, about the time the leaves begin to turn in color, and cured for roughage. This practice of pulling fodder lowers the yield of grain, as has been proved by tests. The ears are later snapped from the standing stalks and stored in bins.

Wheat is the second crop in point of acreage. There were 10,234 acres devoted to wheat in 1909, producing 79,482 bushels or a little more than  $7\frac{1}{2}$  bushels per acre. The crop is thrashed on the farm and ground into flour for home use, the by-products being used in the home or fed to hogs and milk cows.

Oats are the third crop in point of acreage. This crop was grown on a total of 3,057 acres in 1909 and produced 27,825 bushels, or a little more than 9 bushels per acre. Part of the crop is fed in the bundle; part is thrashed and the grain and straw fed to work stock.

In 1909 there were 2,948 acres of cotton in Orange County, which produced 1,430 bales, or an average of nearly 0.48 bale per acre. This yield is considerably higher than the average for the cotton belt as a whole. The same year there were 2,936 acres in tobacco, which produced 1,772,103 pounds, or an average of slightly over 600 pounds per acre. It is quite probable that the present acreage in tobacco is considerably larger, as prices have been high the last few years and many farmers have lately taken up tobacco growing.

According to the census of 1910, the latest for which returns are available, there were 1,185 acres of cultivated grasses cut for hay in 1909, the production from which was 1,291 tons. This includes red clover, alfalfa, and millet. There were 1,423 acres of wild hay cut, producing 1,378 tons; 198 acres of grains cut green; and 105 acres of coarse forage. Large amounts of native pasturage annually go to waste on account of lack of fences to protect it and of stock to consume it. Soy beans and cowpeas of late years have become locally important as hay crops.

Vegetables are grown more or less extensively on every farm. In 1909 there were 73 acres of Irish potatoes, producing 7,007 bushels; 309 acres of sweet potatoes, producing 30,399 bushels; and 878 acres of miscellaneous vegetables.

Sorghum is grown in small patches by many farmers for manufacture into sirup at local mills. There was a total of 101 acres in this crop in 1909.

Orchard products form a profitable side line on many farms. According to the census, there were 36,289 apple trees in Orange County in 1909. These produced 23,686 bushels of fruit. Both summer and winter apples are grown. There were also 34,952 peach trees, which bore 11,496 bushels of fruit. Cherry, plum, and pear trees are numerous and bear well, especially on the red lands.

Muscadine grapes and the different varieties of bunch grapes give good yields. There was a total of 2,881 vines in 1909, which produced 27,919 pounds of fruit. Muscadine grapes grow wild throughout the county.

Of small fruits, strawberries are the only kind mentioned in the 1910 census, which reported a total of 2 acres. Blackberries, dewberries, and strawberries grow wild and each year furnish large quantities of fruit for table use fresh and for canning or drying.

There is a considerable number of pecan trees in the county. The hickory, chinquapin, and black walnut trees growing throughout the wooded areas furnish a large amount of nuts each fall. The oaks furnish vast quantities of acorns, valuable as hog food, and the wild mulberry is often included in the hog pastures.

Such winter cover crops as rye and crimson clover may be grown on every soil in the county, and they are made use of in a small way. Vetch grown in combination with either oats, wheat, or rye makes a good winter cover crop and furnishes an excellent quality of early hay.

Bermuda grass, redtop, orchard grass, white clover, lespedeza (Japan clover), bur clover, and various wild grasses make excellent pasture mixtures. The generally plentiful supply of running water furnished by the spring-fed branches and creeks combines with the abundance of grasses and the mildness of the climate to make conditions well suited for stock raising.

Orange County at present produces a small surplus of beef, consisting principally of old or otherwise unprofitable milk cows, young scrub stock, and veal. The production of a beef type of cattle has received practically no attention until quite recently. There are two or more small herds of purebred Hereford cattle, a like number of purebred Aberdeen Angus cattle, and several grade herds now in the county.

A considerable number of work horses and mules are imported into the county annually, although in comparison with some other North Carolina counties the number is small. There are several registered Percheron stallions in the county, numerous stallions of uncertain breeding, and a number of jacks. However, the brood mare as a work animal has never attained the popularity of the mule in this section.

Most of the farmers raise hogs to supply the home with pork and pork products, and many of them sell pigs, hams, and dressed hogs. There has been considerable interest manifested throughout the county in recent years in improvement of the quality of the hogs. There are at present in the county several small purebred herds, consisting of the Duroc-Jersey, Berkshire, Poland-China, and Chester-White breeds.

Dairying is carried on by several farms, though in a small way. There are one or more herds of purebred Holstein and Jersey cattle. Numerous farmers sell a small amount of butter every week. The cows are mainly of nondescript breeding, but there are some high-grade Jersey, Guernsey, and Holstein animals.

There is a rather clearly defined recognition of the natural crop adaptations of the different soils of the county, but since every farm does not contain the variety of soils best adapted to the ordinary range of crops, it is often necessary to produce certain crops on soils indifferently suited to their production. For instance, considerable wheat is grown on the coarse sandy loams of the county. The market calls for a bright-leaf grade of tobacco. While the red lands will

produce at least as large a yield as the gray lands, it is well recognized that the desired quality can not be obtained on the former, and consequently the sandy areas of the county, such as the northwestern corner, lead in acreage of tobacco. Cotton is restricted largely to the southern half of the county, as it is known to open best at this latitude on the sandy soils. The rolling red lands of the central part of the county are universally considered the best corn, small-grain, and grass soils. While the sandy lands are considered best adapted to early peaches, the red lands are known to be best adapted to apples, especially the winter varieties.

In the handling of the average tract of land in Orange County there is considerable room for adverse criticism. While there are areas so nearly level as to require artificial drainage, over the greater part of the county drainage is excessive and often causes damaging erosion. Some farmers have installed a complete system of well laid out terraces, but more have hurriedly dug ditches of varying gradient and as many more have cultivated the land as it lay, allowing erosion to progress from year to year until the field had to be abandoned. Two general types of terraces are used, the wide cultivated terrace, and the narrow, permanent, sodded terrace, or in some instances rock walls. While a rock wall may often be used to advantage as a dam across gullies too deep and narrow to be successfully terraced, for ordinary field conditions the broad cultivated terrace is more economical of land and less hindrance in cultural operations. Before attempting to build up the productiveness of a field, steps should be taken to see that the soil does not wash away more rapidly than it can be built up.

A practice quite common throughout the county is that of clearing up small scattered tracts of 1 or more acres for cultivation. Frequent instances may be observed over old fields in which the strip of land adjoining the timber, necessarily left idle on account of the impossibility of growing good crops in shade, had grown up in brush and encroached on the cultivated field until it had been abandoned. The topography frequently makes it impossible to have large fields, but in all such cases they should be made as large as conditions allow, in order to reduce the loss of time occasioned by turning.

The prevailing depth of plowing is shallow, averaging about 4 inches for the red lands and 5 for the sandy lands. Breaking is commonly done with light one and two horse turning plows, although a number of the farmers operating large acreages are adopting the two and three horse sulky plows and in a few instances tractor plows. These larger plows are run at a greater depth, and the deeper plowing results in better yields. The old one-horse cultivators, sweeps, and plows are still in general use, but the number of two-horse hoe and

disk cultivators is gradually increasing. Cultivation of the growing crop is in general shallow and frequent.

Preparation of the seed bed is too often a hurried operation, especially on the heavier soils. This is especially true in the case of the small grains and clover. These are often sown broadcast, by hand, on a rough, poorly prepared seed bed, and this lack of care in seeding obviously has much to do with the usually low yields.

Some grain harvesters and drills are in use throughout the county, especially in the sections devoted to general farming, but many farmers still sow by hand and reap with the cradle. Heavier implements and teams for breaking the clay lands and more harrows for pulverizing the soil before planting are most needed.

Farm improvements over the county as a whole are only fair. Very little fencing has been done, many farmers staking their cows out to graze, keeping their work stock in the stall or in small paddocks, and penning the hogs in small inclosures. The barns are small but sufficient to house the live stock and shelter the tobacco, seed cotton, corn, and fodder. Hay is usually stacked in the open. There are perhaps a half dozen silos in the county. In general, the farm buildings and improvements are best through the tobacco belt of the north-western part of the county.

The farmers of this county do not follow a systematic crop rotation, but an increasing number are growing the legumes such as red clover, soy beans, and cowpeas as soil improvers, and rye and crimson clover as winter cover crops. The North Carolina Experiment Station recommends the following three-year rotation: First year, corn; second year, oats and vetch, or crimson clover, with cowpeas; third year, cotton with crimson clover. For the tobacco section a good three-year rotation is as follows: First year, tobacco, followed by crimson clover; second year, corn, followed by wheat; third year, wheat, followed by soy beans or cowpeas, and the latter by a winter cover crop of rye. For the general-farming section the following three-year rotation is recommended: First year, corn, with soy beans and cowpeas sown at the last cultivation; second year, wheat, with red clover; third year, red clover.

The census reports a total of \$65,195 spent for commercial fertilizer by the 88 per cent of farms that reported an outlay for 1909. The amount of fertilizer used has doubtless increased with the expanding acreage of tobacco. This crop is invariably fertilized, the acreage applications ranging from 200 to 500 pounds, generally of an 8-2-2 mixture. Cotton is generally fertilized with 200 to 300 pounds of the same mixture. Before the present high price of fertilizer, corn was universally fertilized with 150 to 300 pounds of an 8-2-2 mixture per acre. At the present time (1918) probably half the corn acreage

is not fertilized; the remainder is given 100 to 200 pounds of various grades of commercial fertilizer, ranging from 10-2-0 to 8-2-2. Wheat and oats are generally given 200 pounds of 16 per cent acid phosphate per acre at the time of planting. Some of the farmers mix their own fertilizers, using acid phosphate and cottonseed meal in varying proportions, the ratio most commonly used being one that produces a 10-2-0 to 9-3-0 mixture. This is applied at the rate of about 300 pounds per acre. Nitrate of soda, when obtainable, is frequently used as a top dressing and side application for growing crops. Soy beans are frequently given an acreage application of 200 pounds of acid phosphate. Barnyard manure is applied to the cultivated crops, but the quantity available is small.

From time to time burnt lime and ground limestone have been used in a small way and their use is apparently increasing. The use of lime has generally been found beneficial.

In recent years there has been an increasing use of the legumes as soil improvers. Experience shows that the expenditures for nitrogen in fertilizers can be materially reduced by growing the legumes in rotation with the clean-cultivated crops and by plowing under winter cover crops. This practice at the same time makes the soil more retentive of moisture, less inclined to wash, less inclined to pack, and generally more productive.

In normal times the labor supply in the county is sufficient, but at present (1918) labor is very scarce. Much of the farm work is performed by the family of the operator, outside help being hired only during the rush season. Normally farm labor commands \$15 to \$20 a month, with board, or \$1 a day. The present wage scale ranges from \$25 to \$35 a month and board, or \$2 to \$2.50 a day.

The census of 1910 reports the average size of the farms of Orange County as 107.2 acres,<sup>4</sup> 39.1 acres of which is improved land. There are many farms that contain from 200 to 300 acres and some that contain 1,000 to 2,000 acres. The percentage of farms operated by owners and tenants is, respectively, 62.6 and 37 per cent. In the greater number of cases the landlord furnishes the stock, tools, and one-half the fertilizer, and receives one-half of all the crops. When the renter furnishes the work stock, seed, and his proportion of the fertilizer the owner receives one-third of the grain crops and one-fourth of the cash crops. Hay lands are generally handled on halves.

There has been a gradual increase in the price of the sandy lands in recent years, the selling value ranging from \$25 to \$75 an acre, depending upon the location and improvements. The red-land section has seen no great increase in selling value as yet, the prices

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<sup>4</sup> Each tenancy is tabulated as a "farm."

ranging from \$10 to \$35 an acre, depending largely upon location and improvements.

#### SOILS.<sup>5</sup>

All the upland soils of Orange County are residual from the underlying rocks. This general section is underlain by slate (most of which is a sheared volcanic rock), diorite, broad diabase dikes, granite, sandstone, shale, a narrow strip of conglomerates, and other rocks. The resultant soils vary with the character of the original rocks and, in the case of some of the soils, with the internal drainage and the degree of erosion to which the decomposed material has been subjected.

There are four principal groups of rocks, each possessing markedly different characteristics and each giving rise to markedly different groups of soils: (1) The so-called slate, an acid volcanic rock that has suffered a shearing, occupying the whole central part of the county; (2) diorites, occupying rather broken areas, occurring mainly in the central part of the county, in association with the slate; (3) granites occurring in the northwestern and southern parts of the county, with various outliers throughout its extent; and (4) sandstones and shales of Triassic age, encountered in the extreme southeastern part of the county. In addition, there are rather extensive areas composed of a combination of two of these formations, viz, aplite cut by diorite dikes and slate similarly cut by diorite. Veins of quartz are of frequent occurrence, especially through the slate and diorite belts, but this rock, owing to its resistant nature, contributes little soil material, although quartz fragments are plentiful over the surface of many areas.

The slate consists of fine-grained rocks, sheared felsites, and rhyolites in large part, which in the unweathered state have a grayish, bluish, or purplish color. The material formed through the decay of these rocks consists largely of silt and clay, with a subsoil color ranging from pale yellow to red, the latter color apparently representing an advanced stage of oxidation resulting from better drainage.

The diorite, a dark-colored, fine-grained, tough rock, locally known as iron rock, contains, among other minerals, plagioclase feldspar—a silicate of soda, lime, and alumina. This rock in Orange County weathers into two distinct and widely differing soils, viz, the Davidson clay loam, a brownish-red soil underlain by a dull-red, friable

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<sup>5</sup> The soils across the boundaries along the Orange and Alamance County lines, and also along the Caswell and Orange County lines, do not in every case conform. Since the making of the Alamance County survey in 1901 and the Caswell County survey in 1908 advances have been made in classification of the soils, and changes made necessary as the result of increased knowledge of the soils of the State. At some future time suitable adjustments will be made to bring the earlier surveys in accord with the later.

clay; and a type with a sticky, plastic, yellowish or greenish-brown clay subsoil and classed by the Bureau of Soils as Iredell material. Differences in drainage and weathering have probably caused the diverse characters in these two soils, rather than any peculiarity in the original rocks. The diorites and diabases are igneous rocks; they have crystallized from a molten mass that apparently has been forced through fissures in other rocks, such as slate, sandstone, and shale, mainly in the form of dikes. Conspicuous examples of these diorite and diabase dikes are those which give rise to the long narrow strips of Iredell soil mapped in the extreme southeastern corner of the county.

The granite is a medium to coarse grained, biotitic granite, high in orthoclase feldspar—a potassium-aluminum silicate. Under the influence of the agencies of weathering the granite disintegrates and decays to give rise to red clay (Cecil material), yellow clay (Durham material), and a mottled red and yellow clay (Appling material).

The Triassic rocks consist of Indian-red or purplish-red sandstone, mudstone, and shale, with some conglomerate. They are composed of material washed from the uplands and deposited in an ancient sea that occupied depressions in the Piedmont Plateau, and subsequently consolidated by cementation of the particles with compounds of iron. They frequently include coal beds, some of which are mined in Chatham County. The Triassic rocks are developed in a disconnected belt extending from the vicinity of Bernardston, Mass., to Hornsboro, S. C. Orange County lies to the west of this belt, only the extreme southeastern corner being composed of this formation. Upon decay these rocks give rise to sandy and clayey soils, varying in color according to local drainage. The principal subsoil colors in Orange County are mottled red and gray (White Store soil material) and yellow (Granville material).

The stream-bottom soils are derived from alluvial material washed down from the uplands and deposited over the flood plains. During every overflow additional material is spread out over the bottoms, so that the soils are still in process of formation. The bottom soils of this county are inextensive. They are uniformly of a brown color, with brown or mottled brown and gray subsoils, and are classified as Congaree material. Small depressed areas, too small to be accurately mapped, occurring in the wider bottoms, are typical of the Wehadkee series.

The soils of Orange County are classified into various types according to the content of stone, gravel, sand, silt, and clay. The types are grouped into series, which include those of similar topography, drainage, color, and origin.

The soils included in the Georgeville and Alamance series are residual from slate rocks. The Conowingo series, closely related to these, occurs associated with slates and frequently receives some material from them. The soils of this series are derived primarily from serpentine and epidote, but in part from diorite.

The Georgeville series includes types having a grayish-brown surface soil underlain by a red, compact, friable clay subsoil. The surface is rolling and drainage is good.

The Alamance series is characterized by gray to almost white, silty surface soils, with yellow, compact, friable silty clay subsoils, mottled in the lower section in places with gray and red. The surface is smoother than that of the Georgeville series, and drainage is fair to good.

The Conowingo series includes types with gray silty surface soils, giving way to a thin intermediate layer of yellow, friable silt loam to silty clay, underlain by a plastic, waxy, yellowish-brown to greenish-brown subsoil. The surface is undulating to rolling and drainage good.

The Davidson and Iredell series are residual from diorite and diabase. The Davidson series is characterized by a dark reddish brown surface soil underlain by a dull-red, friable, smooth, and grit-free clay. The topography is gently rolling to rolling, and drainage is thorough.

The members of the Iredell series have a brownish-gray to brown surface soil underlain by a yellowish-brown or greenish-brown, plastic, impervious clay. The topography varies from nearly level to rolling. Surface drainage ranges from poor to fairly good, except on the steeper slopes, where the rapid run-off is inclined to cause erosion. Underdrainage is deficient.

The Cecil, Durham, and Appling series are residual from granite. The Wilkes series is derived partly from granite and in part from diorite.

The Cecil series is distinguished by its grayish-brown to brownish-red surface soil, underlain by a compact but brittle red clay. The members of this series have a rolling topography and are well drained.

The Durham series is characterized by the yellow color and compact but friable structure of its subsoil. The surface soil is loose and of a light brownish gray color. The topography is undulating to gently rolling and drainage is good.

The members of the Appling series have light brownish gray surface soils and a compact but friable, mottled yellow, gray, and red subsoils. The topography is rolling to steeply rolling, and drainage is good to excessive.

The Wilkes series includes soils derived from aplitic granite with frequent ingression of diorite and diabase dikes. The surface soil is light brownish gray in color. The upper subsoil is usually friable and of a yellow or mottled red and yellow color, but grades at 15 to 20 inches into a brownish-yellow to greenish-yellow, plastic, impervious clay. The topography of the Wilkes soils is gently rolling to broken, and surface drainage is good or even excessive.

The White Store and Granville series are residual from the Triassic sandstone, mudstone, and shale.

The White Store series is characterized by its mottled dull-red and gray, plastic subsoil. The surface soil is grayish in color. The topography of these soils is gently rolling to rolling, and erosion is frequently damaging.

The Granville soils are gray in the surface portion and yellow and friable in the subsoil, frequently with heavier, mottled grayish, yellowish, and reddish lower subsoils. The topography is undulating, and drainage ranges from fair to good. In Orange County only one type is mapped, the Granville fine sandy loam.

The Congaree series is derived from alluvial (stream-bottom) material. The soil is brown to reddish-brown and contains mica flakes. The sediment is of varied origin. The Congaree soils are well drained between overflows.

The following table gives the name and the actual and relative extent of each of the various soil types mapped in this county:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Georgeville silt loam.....	74,176	29.0	White Store fine sandy loam..	3,968	1.5
Davidson clay loam.....	54,784	21.4	Georgeville gravelly silt loam..	3,712	1.5
Conowingo silt loam.....	26,560	10.4	Durham fine sandy loam.....	2,880	1.1
Alamance silt loam.....	14,528	5.7	Appling stony sandy loam.....	2,368	.9
Georgeville stony silt loam....	9,344	3.6	Appling fine sandy loam.....	2,112	.8
Wilkes coarse sandy loam.....	8,320	3.2	Appling coarse sandy loam...	1,600	.6
Durham coarse sandy loam....	8,192	3.2	Iredell stony loam.....	1,152	.5
Appling sandy loam.....	7,872	3.1	Cecil clay loam.....	1,024	.4
Wilkes sandy loam.....	7,680	3.0	Cecil stony loam.....	896	.4
Iredell loam.....	6,592	2.6	Granville fine sandy loam....	576	.2
Congaree silt loam.....	6,400	2.5			
Durham sandy loam.....	6,400	2.5			
Cecil sandy loam.....	4,864	1.9			
			Total.....	256,000	.....

GEORGEVILLE STONY SILT LOAM.

The Georgeville stony silt loam consists of 6 to 8 inches of brownish-gray silt loam underlain by a bright-red compact but friable clay or silty clay. Numerous rocks, ranging in size from mere chips

to large stones of slate (a sheared acid-volcanic rock), quartz, and diorite, lie scattered over the surface and through the soil section. Rock outcrops are of frequent occurrence. In some places the surface rocks may be removed and the land cultivated, but in its present state the soil is so stony as to prohibit cultivation.

Though most of the rocks from which this soil is derived are of a metamorphosed type, consisting of slates with occasional bands of the intruded basic rocks, there are two variations, important from a scientific standpoint, though not necessarily from an agricultural view, in the rock formation. The crest of Occoneechee Mountains, at Hillsboro, is composed of quartzite rocks rightfully classed in the Appalachian Mountain province, and the soil from these would have been correlated with the Herndon series if more than one small area had been encountered. The soil on the extinct volcanic hill in the southern part of the county, known as Mount Collier, differs from the Georgeville stony silt loam geologically in that it shows no shearing, but it has given rise to a soil very similar.

The Georgeville stony silt loam occupies the more prominent hills and some of the larger and rougher stream slopes throughout the slate belt. Its topography is rolling to broken, and the natural drainage is excellent.

Except for small isolated patches, none of this type is in cultivation. The original forest growth was made up of hardwoods, principally oak and hickory; but these have been cut off, and a second growth, consisting of shortleaf pine, various oaks, hickory, poplar, elm, and persimmon, now occupies the land.

The selling value of this type is largely based upon the timber.

#### GEORGEVILLE GRAVELLY SILT LOAM.

The Georgeville gravelly silt loam consists of a grayish-brown silt loam to a depth of 5 to 7 inches, underlain by a bright-red, friable clay. In some places the immediate surface soil is slightly sandy. Small fragments of slate, quartz, and diorite rocks lie scattered profusely over the surface and through the soil section. Occasionally the underlying bedrock outcrops. The organic content of the soil is low, but the presence of the gravel prevents it from packing so badly as does the silt loam type, and it holds moisture better.

The Georgeville gravelly silt loam is of limited extent. It occurs in scattered areas, generally on small knobs and narrow ridges throughout the slate belt. Its topography is gently rolling to rolling, and drainage is good or excessive, although the soil does not suffer from erosion so badly as does the Georgeville silt loam.

This is a rather unimportant soil type. Probably 20 per cent of it is in cultivation. It is primarily a grain and grass soil, and well adapted to general farming. It is suited to the same crops as the

Georgeville silt loam and is handled in the same manner. The presence of the rock fragments makes it somewhat more difficult to handle.

This soil can be improved by the same suggestions that are given for the Georgeville silt loam, namely, proper terracing, deeper plowing, the growing of legumes and cover crops, and the more liberal use of fertilizers high in phosphoric acid and nitrogen.

#### GEORGEVILLE SILT LOAM.

The Georgeville silt loam consists of a light grayish brown to light reddish brown silt loam underlain at a depth of 6 to 10 inches by a bright-red, compact, friable silty clay to clay. The surface soil dries out in many places to yellowish-red color. Small fragments of slate rock frequently occur through the soil and over the surface, and occasionally quartz and fragments of basic rocks. In general, the organic content of the soil is low, and it is inclined to pack after the summer rains.

This is the most extensive soil type in the county. It is found throughout the slate belt, which covers the central part of the county and occupies approximately 80 per cent of this belt. The topography is undulating along the ridge crests and gently rolling to rolling along the stream slopes. Very little of the type is so rolling or broken as to curtail its adaptation to the clean-cultivated crops when properly terraced, although occasional areas, especially along the larger stream slopes, may be too rough for cultivation. Drainage is everywhere thorough.

The Georgeville silt loam is an important soil, probably 40 per cent of it being in cultivation. The remainder either is occupied by a forest growth, consisting principally of old-field pine, various oaks, hickory, cedar, poplar, and dogwood, or is lying idle as old fields.

This soil is primarily adapted to grains and grasses. Corn is the principal crop. Wheat and oats are grown in sufficient quantity for home use and for feeding the work stock. In the southern part of the county a considerable acreage of cotton is grown. Throughout the county small patches are devoted to tobacco; the yield is usually as good as on the lighter soils, if not better, but the quality is inferior. Sorghum, both for molasses and forage, is widely grown. Red clover apparently finds this soil congenial, as it frequently grows wild along the roadside. Soy beans and cowpeas do well, and a considerable acreage is annually devoted to these legumes. Oats or wheat, vetch, and alfalfa are grown in a small way for feed. Rye and crimson clover are occasionally grown for winter pasture and as cover crops. Lespedeza (Japan clover), white clover, Bermuda grass, redtop (herd's grass), orchard grass, bluegrass, and other native grasses grow well and furnish abundant pasture. Most farmers produce their own pork and many have a small surplus to sell on the neighboring markets. Every farmer has one or more milk cows, and

many have some surplus butter to sell as well as some beef, which is commonly marketed as veal. Poultry and eggs are produced in sufficient quantities for home use, with a small surplus for market. Early apples, winter apples, peaches, pears, and cherries are produced on nearly every farm, and small quantities are available for the local markets. Small fruits and garden vegetables all give good yields.

Corn ordinarily yields from 10 to 25 bushels per acre, but occasional yields as high as 50 bushels or more are obtained on the best handled tracts. Wheat ordinarily yields 5 to 15 bushels per acre, but 30 to 40 bushels may be obtained under good methods. Oats yield 20 to 50 bushels per acre, and cotton returns from one-third to 1 bale per acre. Tobacco yields from 400 to 800 pounds per acre. Soy beans and cowpeas yield 10 to 15 bushels of seed or about 1 ton of hay per acre, with proper treatment.

The handling of this soil is generally inefficient. In most cases it is plowed to only a shallow depth, with light plows drawn by one or two mules. Some of the better farmers are using two and three horse sulky plows, or in a few cases tractor plows, and are gradually increasing the depth of breaking. Very frequently there is a lack of proper attention in the preparation of the seed bed, especially for the small grains. Small one-horse cultivators, sweeps, and plows are in general use for tilling the clean-cultivated crops. There is no general adoption of any certain crop rotation, although most farmers alternate the small grains and cultivated crops with the legumes.

Commercial fertilizer is used to some extent, although during the last few years, since fertilizer has been so high priced, many farmers have curtailed its use. Corn generally receives from 150 to 200 pounds per acre of commercial fertilizer of varying analysis, ranging from 8-2-2 to 9-2-1, 9-1-2, and 10-2-0. Wheat and oats are given about 200 pounds per acre of 16 per cent acid phosphate, or of a commercial fertilizer analyzing about 10-2-0. Some farmers fertilize more liberally, and a limited number use a top dressing of 75 to 100 pounds per acre of nitrate of soda in the spring. Cotton is generally given 200 to 400 pounds of fertilizer of the same grade as is given corn. Tobacco receives 200 to 400 pounds of an 8-2-2 fertilizer per acre. All the available barnyard manure is applied to the cultivated crops.

The selling price of this land ranges from \$10 to \$40 an acre, depending upon the location, improvements, and area under cultivation.

There is considerable room for improvement in the handling of this soil. It is low in organic matter and washes readily, as is evidenced by the numerous abandoned gullied fields and the washes in the fields now in cultivation. Before attempting to build up the soil, it should be put in such condition that it will withstand erosion. Both ditches and narrow terraces of varying gradient are used to some extent.

The broad cultivated terrace with a carefully surveyed fall is to be recommended, as it provides adequate protection against all normal rains and also obviates the necessity of having the ditch or narrow weedy terrace, either of which renders useless more or less land.

There should be a general increase in the depth of breaking this soil. While on the better managed farms the depth of plowing is being increased, in general the breaking process consists of merely scratching the surface with small one or two horse turning plows. Fall plowing, which exposes the raw soil to the beneficial action of the alternate winter freezes and thaws, is to be recommended. It will necessitate heavier machinery and work stock, but will in turn make the man-power unit more efficient.

The more general growing of the legumes in rotation with the cultivated crops, and in the cultivated fields, and the growing of winter cover crops in order to build up the organic content of the soil, are important measures. There should be a definite rotation of the cultivated and noncultivated crops. The following three-year rotation should prove profitable: First year, corn with cowpeas and soy beans sown at the last cultivation, the corn to be cut and the land sown to wheat; second year, wheat with red clover sown in the spring; third year, red clover.

Experience indicates that phosphoric acid and nitrogen are the two most needed fertilizer elements on this soil. Through the growth of the legumes and winter cover crops the nitrogen content of the soil may be readily built up, but in this building-up process a more liberal use of the nitrogen element, as in the form of cottonseed meal, should prove profitable. Home-mixed fertilizers composed of 16 per cent acid phosphate and 7 per cent cottonseed meal, mixed in the proportion of 2 to 1½, respectively, and applied at the rate of 300 to 400 pounds per acre for corn, cotton, and small grains should prove profitable. In growing tobacco the use of potash is essential, and fertilizers analyzing 8-2-2 to 8-3-3 have proved satisfactory in this section. Lime, applied in the form of ground limestone, at the rate of 1 to 2 tons per acre, will be found beneficial in sweetening the soil, improving its structure, and making available plant food. Liming is especially helpful in growing the legumes and grasses.

In view of its natural adaptation to the grasses and forage crops, this type of soil should prove well suited to a system of live-stock farming under which a large proportion of the fertilizing elements taken from the soil by the growing crops may be returned in the form of manure.

#### ALAMANCE SILT LOAM.

The surface soil of the Alamance silt loam is a light-gray to almost white, floury silt loam passing at 3 to 5 inches into a pale-yellow silt loam which extends to a depth of 8 or 10 inches. The subsoil

is a yellow, compact, friable silty clay frequently mottled with gray in the lower part of the 3-foot section. Small fragments of slate and quartz occasionally occur on the surface and throughout the soil, but rarely in sufficient quantities to affect its handling qualities. There are, however, several small, irregular areas, especially in the southwestern part of the county, that would be mapped as a stony silt loam if their extent justified the separation. These areas are included with the surrounding types. The organic content of the soil is low, and this deficiency, together with its fine texture, causes the soil to pack badly following the summer rains, makes crops liable to damage from drought, and induces destructive erosion on the slopes.

The Alamance silt loam occurs throughout the slate belt, but most extensively in the southwestern part of the county. The largest individual areas are mapped in the vicinity of Buckhorn.

The topography is gently undulating to gently rolling. The more nearly level areas are generally poorly drained and require ditching for the most satisfactory results. The sloping areas are usually well drained. Care must be taken everywhere not to plow or cultivate the land when wet, as it has a tendency to clod.

The Alamance silt loam is of only moderate extent, but owing to its favorable topography a relatively high percentage of it is in cultivation. Most of the unfarmed areas have at one time been in cultivation, as is evidenced by remaining signs of corn and cotton beds, but they now support a second growth of shortleaf yellow pine, various oaks, hickory, poplar, and dogwood, with some cedar and persimmon. In every open spot there is a heavy growth of broom sedge.

A considerable acreage of this type is annually devoted to cotton and tobacco, but corn is the principal crop. Wheat and oats are widely grown. Red clover, soy beans, and cowpeas are grown for both hay and seed. Rye and crimson clover are grown to some extent as winter cover crops. The common tree fruits, small fruits, and vegetables of this section are successfully grown. Most farmers raise enough cattle, hogs, and poultry to supply home needs and have a small surplus for market. Japan clover, white clover, Bermuda grass, redbtop, orchard grass, and various wild grasses thrive and offer natural advantages for the raising of live stock. The methods of plowing, cultivation, and fertilization that prevail throughout the county are employed on this type.

The present selling value of this land ranges from \$10 to \$35 an acre, depending upon the location, improvements, and amount of land in cultivation.

The principal needs of the Alamance silt loam, as shown by the experience of farmers and as indicated by the physical characteristics

of the soil, are deeper plowing, the incorporation of vegetable matter by turning under such winter cover crops as rye and crimson clover, and the building up of the nitrogen content through the growing of more red clover, soy beans, and cowpeas. With such treatment and with an acreage application of about 400 pounds of fertilizer, analyzing about 10-3-3, farmers in various parts of the slate belt of North Carolina have produced on this type of soil as much as 50 bushels or more of corn, 20 bushels of wheat, or 1 bale of cotton, per acre. For cotton, which is sometimes late in maturing, this soil seems to need a fertilizer high in phosphoric acid, and one containing about 12 per cent would probably give better results than the present commonly used low-grade mixtures. The physical properties of this soil strongly indicate a need of lime. An acreage application of 1 to 2 tons of ground limestone would have a beneficial effect. As this type of soil is primarily adapted to grain and grass crops, it would seem that a system of live-stock farming should be profitable.

#### CONOWINGO SILT LOAM.

The Conowingo silt loam consists of a light-gray to almost white, floury silt loam extending to a depth of 5 to 8 inches, where it passes through a pale-yellow compact silt loam to silty clay loam slightly streaked with gray. This extends to a depth of 14 to 20 inches below the surface. The subsoil is a tough, plastic, yellowish-brown to greenish-brown clay, resembling in all characteristics the subsoil of the Iredell soils. Small iron stains and concretions frequently occur throughout the soil section, especially in the larger and more nearly level areas of the type. Small gravel, composed of slate and quartz fragments, frequently occur on the surface and through the soil, though rarely in quantities sufficient to influence the soil character. The organic content of the soil is low, and cultivated fields are likely to pack and bake after rains. The type is locally known as "gray gravelly land."

This soil occurs in close association with the Alamance silt loam throughout the slate belt, in comparatively small, irregular areas. The topography is level to undulating and in places rolling, and drainage is poor, especially through the more nearly level tracts, where water stands on the surface for some time after rainy periods and leaves the soil in a cold, water-logged condition during the winter and spring months. Ditching is necessary in these areas, and even then the soil is late in coming into a cultivable condition; in addition, crop growth may be retarded by an unusually heavy precipitation. Owing to the impervious character of the subsoil, the surface drainage in the rolling areas is at times excessive, resulting in serious erosion.

The Conowingo silt loam covers an area of 41.5 square miles. Approximately 40 per cent of it is in cultivation, the remainder supporting a growth of blackjack oak, white oak, post oak, cedar, pine, and persimmon. On the flatter areas there is a conspicuous growth of gray moss, huckleberry, and wild vetch.

This is primarily a grain soil, but in the southern part of the county some cotton is grown and throughout the county there are small fields on the better drained areas on which tobacco is grown. Soy beans, cowpeas, and red clover are generally grown. Grasses thrive on this soil; there are numerous excellent small pastures of Bermuda grass and white and Japan clover. The common orchard fruits, small fruits, and garden vegetables produce well on the better-drained areas. The farms generally produce the products needed on the farm. They produce the home supply of pork and a small surplus for sale, keep one or more milk cows which furnish some butter and an occasional veal calf for market, and support sufficient poultry to meet the home needs and provide a surplus of eggs and chickens for sale.

Corn ordinarily yields 10 to 25 bushels per acre, and occasional better farmed fields yield 30 to 35 bushels. Wheat yields 5 to 12 bushels per acre, and oats from 15 to 25 bushels. As in the case of corn, considerably higher yields are obtained with good farming methods. Cotton yields one-fourth to three-fourths bale per acre, and tobacco from 350 to 600 pounds. Soy beans and cowpeas yield well and produce a good vine.

This soil is not generally handled to the best advantage. The breaking is done with light one or two horse turning plows, and is too shallow. The seed bed, especially for the small grains, frequently is hastily prepared and left in a cloddy condition. There is no regular crop rotation, although the fields are given an occasional respite from clean cultivation by the sowing of red clover. Some of the better farmers grow soy beans or cowpeas with the clean-cultivated crops, sowing them at the last cultivation, and others are making use of rye and crimson clover as winter cover crops.

Commercial fertilizers are generally used on this soil. Before the rise in fertilizer prices the 8-2-2 mixture was in standard use for all crops. At present tobacco is the only crop that invariably receives this grade of fertilizer, from 200 to 400 pounds per acre being distributed. Commercial fertilizers ranging in analysis from 8-2-2 through 9-2-1 to 10-2-0 are used for corn and cotton, in amounts of 150 to 300 pounds per acre and 200 to 350 pounds per acre, respectively. Wheat and oats generally receive 200 pounds of 16 per cent acid phosphate or a like amount of a 10-2-0 fertilizer.

Nitrate of soda is used as a top dressing and side application for growing crops by many farmers, when available. A few farmers are

making a home mixture of acid phosphate and cottonseed meal, proportioned so as to approximate a 9-3-0 mixture; this is applied at the rate of 200 to 300 pounds per acre for the small grains. Soy beans are in some cases given an acreage application of 200 pounds of 16 per cent acid phosphate, while in others they receive no fertilizer. Cowpeas are not generally fertilized. All the barnyard manure available is applied to the cultivated crops, but the amount produced is small.

The selling price of this land ranges from \$10 to \$30 an acre, depending upon the location, improvements, and percentage of cleared land.

Owing to the fine texture, a natural tendency to pack and bake, and the impervious character of its subsoil, growing crops on the Conowingo silt loam are liable to serious injury during protracted drouthy spells. The level areas are wet and cold in the spring and the more sloping areas are subject to damaging erosion. The principal needs for the successful handling of this soil are the ditching of the level areas, deeper plowing, the incorporation of vegetable matter, and the growing of more legumes, such as red clover, soy beans, and cowpeas, in rotation with the cultivated crops. The physical properties of this soil strongly indicate a need of lime. An acreage application of 1 to 2 tons of ground limestone would have a beneficial effect.

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

*Mechanical analyses of Conowingo silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
234601.....	Soil.....	1.2	2.8	1.6	9.4	26.6	52.8	5.6
234602.....	Subsoil.....	1.2	1.6	.8	4.5	17.2	51.9	23.0
234603.....	Lower subsoil...	.0	.8	.4	3.8	12.2	35.6	47.2

DAVIDSON CLAY LOAM.

The Davidson clay loam to a depth of 6 to 12 inches consists of a dark-brown or reddish-brown to dull-red, heavy loam to clay loam, underlain by a dull-red or maroon-red, smooth, friable clay. The deeper, more loamy, and more brownish soil occurs in the wooded areas, while over the cultivated fields, more or less affected by erosion, the surface soil is shallower, heavier, and redder. A lack of quartz grains through the subsoil results in a characteristic smooth, velvety feel in this section of the 3-foot profile. Along the crests of some of the narrower ridges there are occasionally found more or less

rock fragments, mostly of diorite, lying over the surface, and an occasional outcrop of the bed rock. Wherever the size of these areas justifies they are indicated on the map by stone or rock-outcrop symbol as the case may be.

The Davidson clay loam is of considerable agricultural importance, owing to its large extent and its excellent adaptation to the general farm crops of corn, wheat, oats, and the various legumes.

The type occurs through the central part of the county, generally along stream slopes. Its topography varies from gently rolling to rolling. Only on an occasional stream slope is it too steep for the growing of the clean-cultivated crops, and these areas are excellently adapted to pasturage.

The Davidson clay loam is derived principally from basic rocks such as diorite, diabase, and hornblende schist. The rock has generally weathered deeply as compared with the other soil-forming rocks of the county, bedrock being very rarely reached in the 3-foot section, and, as evidenced by road cuts and well borings, occurring at a depth of 15 to 20 feet. The soil has had the benefit of thorough drainage, resulting in its bright, live color and friable structure.

The original forest growth on this soil was made up mainly of hardwoods, consisting of various oaks, hickory, cedar, elm, poplar, locust, walnut, wild cherry, and persimmon. Areas once cultivated and later "turned out" support mainly a growth of old-field pine, cedar, sweet gum, elm, oak, hickory, and black walnut. Broom sedge makes a rank growth in these old fields. When the land is closely pastured Japan clover grows naturally. The greater part of the red cedar shipped from Orange County is cut on this soil.

The Davidson clay loam is naturally strong and productive and may be easily brought into a highly productive condition. Chemical analyses show it to be comparatively well supplied with nitrogen, phosphoric acid, and lime, but low in potash. This is probably the best grain and clover soil in the county. Corn averages about 23 bushels per acre, although some of the better farms produce 40 to 60 bushels. Wheat yields average about 8 bushels, but occasional yields of 40 bushels are obtained. Oats range from 20 to 40 bushels per acre. Tobacco is occasionally grown, but does not produce a leaf of bright color or fine quality. Cotton makes a good growth, but frequently the bolls do not open well. Red clover is well suited to this soil and grows wild along the roadside. A good stand is usually obtained and a satisfactory quality of hay produced. Alfalfa is frequently grown in small fields, but under the prevailing methods of farming it does not stand well for more than a year or two. Soy beans and cowpeas give satisfactory yields of both hay and seed. The various truck and garden crops produce well. Apples, cherries,

pears, peaches, and plums, and the small fruits are long lived and produce well. Apples give especially good results. The native grasses, Bermuda grass, and Japan clover thrive on this soil. Rye, crimson clover, vetch, and rape are well adapted for use as grazing crops, winter cover crops, and green manures.

A system of grain farming predominates on this soil. Sufficient quantities of grain, hay, fruit, garden vegetables, pork, and dairy and poultry products are produced for home use, with more or less surplus for sale. Frequently the farms on this type include a small acreage of the lighter soils, which are used for growing tobacco and cotton.

Under normal conditions moderate amounts of commercial fertilizer are used by many farmers on this soil. Ready-mixed fertilizer analyzing 8-2-2 is used at the rate of 150 to 300 pounds per acre on corn. An acreage application of 200 pounds of 16 per cent acid phosphate is usually given oats and wheat. Barnyard manure is applied to corn in the spring and to wheat in the fall. Legumes and winter cover crops are grown for improvement of the soil by a number of the better farmers.

Owing to the heavy character of this soil it can not be handled under as wide a range in moisture conditions as can the sandy soils. If plowed when too wet it will puddle and bake, while if too dry it will clod badly. There are several tractor plows, a number of sulky turning plows, and numerous two-horse walking plows on the farms, but over a considerable portion of the type one-horse turning plows are still in use. With a few exceptions the farm equipment is inadequate.

With the exception of several highly improved farms, selling values on the Davidson clay loam range from \$10 to \$30 an acre, depending largely upon the location and improvements.

Terracing, deeper plowing, and the incorporation of organic matter are the foremost needs of this soil. Numerous fields of rolling topography, where little or no precaution has been taken against erosion, have washed and gullied to such an extent that the cultivable area has been reduced to small patches interspersed with numerous draws and gullies. With proper terracing many of these may be brought back to a tillable condition, while others after being terraced should be sown to pasture grasses. There should be a general increase in the depth of plowing from year to year from the present average of 3 or 4 inches to 8 or 10 inches. Fall plowing, followed by winter cover crops or even fallow, has a beneficial effect upon the soil through exposing the upturned material to the alternate winter freezes and thaws.

A definite crop rotation should be followed. A good three-year rotation recommended is as follows: First year, corn, with cowpeas sown at the last cultivation; second year, wheat and red clover; third year, red clover.

Owing to its adaptation to grains, legumes, and grasses, the favorable climatic conditions, the abundance of water, and its generally low price, this soil is especially well suited to stock farming.

#### IREDELL STONY LOAM.

The Iredell stony loam consists of a gray to light-brown, heavy loam passing at a depth of about 8 inches through a brownish-yellow, friable silty clay into a plastic, impervious yellowish-brown to greenish-yellow clay. The latter is reached at about 12 inches and extends to a depth of 24 to 30 inches, where it grades into rotten rock. The lower subsoil is frequently mottled brown, drab, and blue. Basic rocks, principally diorite, of varying size, are scattered thickly over the surface, and the bedrock outcrops in many places.

This soil occurs chiefly through the eastern and southeastern parts of the county. It is of small extent. Only a very small part of it is in cultivation, the remainder either supporting a forest of blackjack oak, hickory, cedar, and pine or lying out as old fields with a luxuriant growth of broom sedge, Japan clover, and other native grasses.

The Iredell stony loam occurs both along hill slopes, where its topography is rolling to broken, and in a few cases over wide flats, where drainage is deficient.

With the exception of small, isolated patches this soil is too rough and stony to be successfully cultivated. Wherever possible it should be reforested or used as permanent pasture land.

#### IREDELL LOAM.

The Iredell loam consists of a gray to dark rusty brown loam passing at a depth of 6 to 8 inches through a thin layer of brownish-yellow, friable silty clay. The subsoil is a stiff, plastic, yellowish to greenish-brown clay, which may extend to a depth of 3 feet, but which generally passes into greenish-yellow disintegrated diorite rock at 24 to 30 inches. Drab and bluish mottlings usually occur in the lower subsoil. Small black iron concretions in many places occur thickly over the surface and through the soil, and occasionally through the subsoil. Outcrops of the parent rock are numerous and in many places handicap farming operations, especially the growing of grains.

This soil occurs mainly in small, irregular areas throughout the county, but especially in the southern half. It is derived from dikes of basic rocks and frequently occupies long, narrow strips, especially in the extreme southeastern corner of the county.

The largest single area of Iredell loam is mapped between Blackwood and Balls Mountains. It comprises about 2 square miles, and is locally known as "Big Meadows."

With the exception of occasional strips and patches along streams, slopes, and hillsides, the surface of this soil is nearly level. Under-

drainage is poor, owing to the impervious nature of the dense clay subsoil, and the run-off is slow in many places, especially over the larger areas.

Owing to its relatively small extent, this type is not of much importance agriculturally. Not over 15 per cent of it is in cultivation. The uncultivated areas support a growth of oak, blackjack oak, cedar, hickory, gum, poplar, dogwood, and pine. Where the shade is not too dense there is a luxuriant growth of broom sedge, Japan clover, and other native grasses.

It is said that some of the larger areas of this soil were natural prairie, and that at the time Hillsboro was first settled the farmers each year came down to the area now known as the "Big Meadows" and cut and cured hay from the native grasses. Since then the area has grown up to forest.

The general farm crops of corn, small grains, red clover, and grasses are grown on this soil. When the season is favorable, neither very dry or very wet, good results are obtained.

The Iredell loam is a difficult soil to plow deeply, especially where the sticky clay subsoil comes near the surface. If it is plowed when wet, clods are formed which are difficult to pulverize. If allowed to become dry and bake, it is also difficult to handle. The type is tilled and fertilized in about the same way as the associated types.

The heavy Iredell soils such as this are generally considered as best adapted to the production of the shallow-rooted crops, such as small grains and grasses, but on the whole this soil is quite well suited to corn and cotton. It would seem that the most practical use for much of the type would be as permanent pasture.

#### CECIL STONY LOAM.

The Cecil stony loam consists of a grayish-brown to brown loam to sandy loam underlain at a depth of 6 to 10 inches by red clay. Numerous rock fragments are scattered over the surface, and rock outcrops are of frequent occurrence.

The Cecil stony loam is confined principally to a few small areas in the southeastern part of the county. The topography is rolling and drainage is good.

Practically all of this type is occupied by a growth consisting principally of pine, oak, hickory, cedar, and dogwood. Owing to the numerous rocks lying on the surface and through the soil, it is not suited to agricultural use, but is available for forest or pasture land.

#### CECIL SANDY LOAM.

The Cecil sandy loam consists of a grayish-brown to brown sandy loam to a depth of 6 to 10 inches, underlain by a red, heavy, compact, but brittle clay. There are some local variations in the type, but

none of sufficient extent to warrant separate classification. To the north of Chapel Hill, along Bolin Creek, principally on its northern side, and along the north side of Morgan Creek the type is strongly rolling, with much more surface relief than typical. These areas would be mapped as Cecil sandy loam, rolling phase, if their total extent warranted. The soil is coarser in texture as the creek is approached, in some places grading close to a coarse sandy loam.

The Cecil sandy loam occurs in small areas scattered throughout the various granite belts of the county. Its topography is prevailingly rolling. Drainage is everywhere good, and frequently excessive.

Probably 70 per cent of this soil is cleared and in cultivation. It is naturally strong and productive, and easily handled. The uncultivated areas are mainly covered with a second growth of pine, various oaks, hickory, cedar, and dogwood.

Cotton is the principal crop, especially through the southern half of the county. Corn, wheat, oats, red clover, soy beans, and cowpeas are the most important subsistence crops. Rye and crimson clover are successfully grown for winter cover. Sorghum, peaches, apples, cherries, pears, Muscadine grapes, sweet potatoes, Irish potatoes, and all the vegetables common to this section are successfully grown.

Cotton yields range from one-third to 1 bale per acre. Corn yields 15 to 40 bushels, wheat 5 to 30 bushels, and oats 20 to 40 bushels per acre, depending to some extent on the season but mainly on the handling of the soil.

This type is handled in about the same way as the other upland soils of the county. Breaking is ordinarily 4 or 5 inches deep, and the cultivation of the growing crops is shallow and frequent. Light one and two horse implements are commonly used.

Commercial fertilizers are in general use on this soil. For cotton an application of 200 to 400 pounds of a ready-mixed fertilizer analyzing 8-2-2 is generally made. Corn receives a smaller application and frequently lower grade mixtures. Wheat and oats are generally fertilized with 200 pounds of 16 per cent acid phosphate. In a few instances cottonseed meal is mixed with the acid phosphate.

The present selling value of land of this type ranges from \$15 to \$60 an acre, according to the location and improvements.

The prevention of erosion through proper terracing and contour cultivation is of paramount importance on this soil. The steeper slopes should be properly terraced, seeded only to such soil-binding crops as Bermuda grass and Japan clover, and used for pasture.

The experience of the better farmers show that the legumes such as red clover, soy beans, and cowpeas should be grown in rotation with such crops as corn and cotton to replenish the nitrogen supply

of the soil. Fall plowing, followed by a winter cover crop to be turned under in the spring, has been found beneficial as a means of adding organic matter to the soil, improving the tilth, and preventing erosion.

Tests made by the State agricultural experiment station on the Cecil sandy loam indicate that cotton requires very little potash, that corn shows practically no benefit from it, and that little benefit is derived from the use of lime alone for either cotton or corn.<sup>6</sup>

#### CECIL CLAY LOAM.

The Cecil clay loam in its typical development consists of a brownish-red clay loam underlain at 4 to 5 inches by a compact but brittle red clay. In some places there is a shallow surface layer of sandy loam or loam, but in most of these patches the soil becomes a clay loam after plowing. On the other hand, there are small spots where the surface soil has been completely eroded, leaving the red clay exposed.

The Cecil clay loam is an inextensive type. It occurs principally in the southern part of the county, the largest single area lying west of Mount Moriah Church.

The topography is rolling and surface drainage is thorough or even excessive on some of the slopes.

Owing to its small extent, this is not an important soil, although a large part of it is under cultivation. Cotton is the principal cash crop. Corn, wheat, oats, red clover, soy beans, cowpeas, and the various grasses are successfully grown. Cotton yields from one-third to 1 bale per acre and corn 15 to 40 bushels.

Heavy teams and implements are necessary for the efficient handling of this soil. It can not safely be plowed when wet. It is naturally low in organic matter and difficult to work into a good seed bed. While deeper plowing is advisable, it is not a good plan to increase the depth of plowing more than 1 or 2 inches in a single year. Applications of lime have proved beneficial on this soil in various parts of the Piedmont region, improving the tilth and increasing the yields of crops, especially the legumes.

#### DURHAM COARSE SANDY LOAM.

The surface soil of the Durham coarse sandy loam consists of a light-gray to brownish-gray coarse loamy sand to coarse sandy loam extending to a depth of 4 to 6 inches. It passes into a pale-yellow or yellowish-gray loamy coarse sand to coarse sandy loam which extends to a depth of 10 to 15 inches. The subsoil is a bright-yellow, coarse sandy loam which gradually becomes finer textured and grades into a bright-yellow, friable clay to sandy clay at a depth ranging from

<sup>6</sup> See Buls. Nos. 227 and 229, N. C. Agr. Expt. Sta.

16 to 24 inches. In the virgin state or in forested areas and in fields that have not been in cultivation for some time the surface soil is characteristically lighter colored than in the cultivated fields. The depth to the clay subsoil is shallow in some places on the slopes where the surface soil has been subject to erosion. Fragments of the parent rock, a coarse gray granite, occur over the soil in places, and the bed-rock occasionally outcrops.

In its natural condition this soil contains little organic matter, but owing to its loose structure it is easy to cultivate, requiring only light teams and implements.

The Durham coarse sandy loam is most extensive in the northwestern part of the county, about Carr. Smaller but important areas occur in the central part north of Efland, and in the southern part of the county in the vicinity of Damascus Church and near the Carrboro-Pittsboro Road. Its topography varies from nearly level or undulating along the ridge crests to gently rolling and rolling along the stream slopes. Drainage is well established and is excessive on some of the steeper slopes. Water percolates through the soil so rapidly that plowing may be safely done soon after rains. In fields that have become impoverished through careless farming methods crops suffer severely during protracted dry spells, but where a good supply of organic matter has been maintained little or no damage is noticed from droughts.

The Durham coarse sandy loam is not an extensive type, but it is important from an agricultural standpoint. Probably 60 per cent of it is in cultivation, and the area under the plow is increasing. There are probably more well-improved farms on this type than on any other soil in Orange County. The uncultivated areas are mainly forested with a second growth of pine, various oaks, and dogwood.

Tobacco is the principal crop. Cotton occupies a large total acreage in the southern areas of the type. Most farmers produce enough corn to feed the work stock and hogs, and enough hogs are raised to supply the home with pork products. Wheat and oats are also grown for home and farm use. Cowpeas and soy beans are grown to a considerable extent for hay, as a soil improver, and for the seed. Among the other crops grown for use on the farm or as soil improvers are sweet potatoes, Irish potatoes, tomatoes, and other vegetables, sorghum, rye, crimson clover, and peanuts. Peaches, early apples, winter apples, cherries, pears, Muscadine grapes, and various small fruits produce well. Most farmers have a small patch of water-melons and cantaloupes, and some melons are sold on the local markets. This is probably the earliest soil in the county for all crops.

Tobacco yields from 400 to 800 pounds of high-grade bright-leaf tobacco per acre. Cotton yields from one-third to three-fourths bale

per acre, corn 10 to 30 bushels, wheat 5 to 15 bushels, and oats 15 to 30 bushels. Sorghum made from the cane grown on this soil is of a good, light color and excellent flavor. Yields of all crops vary with the amount of fertilizer or manure used.

Commercial fertilizers are generally used on tobacco, cotton, corn, and the small grains. Nitrate of soda, if procurable, is used as a top dressing or side application on these crops. Applications of 250 to 500 pounds of an 8-2-2 mixture per acre are made for tobacco, and a somewhat lighter application for cotton. An acreage application of 200 to 300 pounds of an 8-2-2 or lower grade fertilizer is made for corn. Wheat and oats are fertilized with either 16 per cent acid phosphate or a mixture of acid phosphate and cottonseed meal, at the rate of 200 to 300 pounds per acre. Soy beans and cowpeas are usually grown in rotation with the cultivated crops, and cowpeas are occasionally sown in corn at its last cultivation, to be turned under for replenishing the supply of organic matter.

The present selling value of this soil ranges from \$25 to \$75 an acre, according to the location and improvements.

Well suited as it is to the leading cash crops of the South, tobacco and cotton, this soil has apparently given a better margin of profit than the other soils of the county, as is evidenced by the numerous well-improved farm homes.

The foremost needs of the Durham coarse sandy loam in Orange County apparently are the prevention of erosion through a proper system of terracing; the growing of more legumes, such as soy beans and cowpeas, in rotation with the clean-cultivated crops, to reduce the fertilizer expenditure, particularly for nitrogen; and the turning under of winter cover crops of crimson clover or rye.

#### DURHAM SANDY LOAM.

The Durham sandy loam consists of a gray to brownish-gray sandy loam, passing at a depth of 2 to 6 inches, through a pale-yellow sandy loam, into a bright-yellow, friable sandy loam. The latter extends to any depth ranging from 6 to 15 inches. The subsoil is a bright-yellow, friable clay or sandy clay. In occasional areas fragments of the parent rock, a light-colored, medium-grained granite, lies scattered over the surface, and in some places bedrock outcrops.

This soil is confined mainly to the northwestern part of the county, with smaller but important areas in the southern part, particularly in the vicinity of White Cross and Fairview School and along Phils Creek.

The topography ranges from undulating along the crests of the wider ridges to rolling as the larger streams are approached. Drainage is ordinarily good or even excessive, except in occasional small, depressed, soggy areas. Fields in which the original organic content

of the soil has been maintained rarely suffer from a lack of moisture except in case of severe drought.

Although of small extent, this soil is of considerable agricultural importance, owing to its adaptation to the cash crops. Probably 60 per cent of it is cleared and in cultivation. The uncultivated areas are occupied by a growth of old-field pine, various oaks, and dogwood.

Tobacco is the principal crop on this soil. Cotton is a crop of importance on this soil in the southern part of the county. Corn, wheat, and oats are grown in sufficient quantities for home and farm needs. Cowpeas and soy beans are grown for hay or seed and as a means of improving the soil. Crops mature early on this soil. Tobacco yields from 400 to 800 pounds per acre, depending upon the condition of the soil, the fertilization, and the seasonal conditions. The Durham soils are generally recognized as being especially suited to the bright-leaf variety of tobacco, and a grade commanding a high average price is produced on this soil. Cotton yields from one-third to two-thirds bale per acre. Corn yields 15 to 30 bushels, wheat 5 to 15 bushels, and oats 20 to 30 bushels per acre. The legumes fruit well and produce a fair yield of hay. Of the crops of lesser importance, garden vegetables, peanuts, rye, crimson clover, vetch, sorghum, melons, Muscadine grapes, apples, peaches, cherries, and pears succeed. This soil may be successfully handled with lighter implements and work stock than are required on the red lands of the county. Plowing is ordinarily 4 or 5 inches deep, and the cultivation is shallow and frequent.

Commercial fertilizers are generally used. Tobacco is given an acreage application ranging from 200 to 800 pounds of an 8-2-2 mixture. Cotton and corn are given a lighter application of the same or a lower grade of fertilizer. The small grains, wheat and oats, usually receive 200 pounds of 16 per cent acid phosphate or a 10-2-0 mixture. Nitrate of soda, when obtainable, is frequently used as a top dressing or side application for growing crops. Soy beans and cowpeas are grown in rotation with the cultivated crops, and occasionally are turned under to replenish the organic content of the soil.

The present selling value of this soil ranges from \$25 to \$75 an acre, depending largely upon the location and improvements.

The productiveness of the Durham sandy loam in Orange County apparently can best be increased by means of terracing the rolling areas, growing more legumes in rotation with the clean-cultivated crops, and occasionally turning under a winter cover crop of rye or crimson clover. Deeper plowing wherever tried has proved beneficial, especially for the grain crops. It is probable that the application of 1 or 2 tons of ground limestone per acre after plowing would be of material benefit.

## DURHAM FINE SANDY LOAM.

The surface soil of the Durham fine sandy loam consists of a light brownish gray fine sandy loam or loamy fine sand, grading at 3 to 4 inches into a pale-yellow fine sandy loam. This is underlain at depths ranging from 8 to 14 inches by a bright-yellow fine sandy clay, which quickly passes into a yellow, friable clay, often slightly mottled in the lower part with red. Small quartz gravel generally occurs in small quantities over the surface and through the soil section.

The organic content of the virgin soil is rather low. In cultivated fields, where vegetable matter has been worked into the soil, there is a pronounced difference in color between the immediate surface layer and the underlying material. The soil is easily cultivated and handled.

This type is most extensive in the southwestern part of the county surrounding Antioch Church. A smaller area occurs in the extreme northeastern corner. The topography is generally undulating along the ridge crests and divides, and gently rolling along the stream slopes. Drainage is good.

This is an inextensive type, but probably 50 per cent of it is in cultivation. Tobacco and cotton are the principal crops. Most farmers produce enough corn for the work stock and the hogs raised and fattened for home consumption. Wheat, oats, sorghum, soy beans, and cowpeas are grown more or less extensively on every farm. Crimson clover and rye are frequently grown as winter cover crops. Red clover is occasionally seeded. Watermelons, cantaloupes, sweet potatoes, Irish potatoes, tomatoes, various tree fruits, and small fruits do well. This is an early soil for all crops.

Tobacco yields from 400 to 700 pounds per acre, and cotton from one-fourth to two-thirds of a bale. Corn yields from 10 to 30 bushels, wheat 5 to 15 bushels, and oats 15 to 30 bushels per acre. Both soy beans and cowpeas fruit well and generally produce a good growth of vine.

Light one and two horse turning plows are used to break this soil. The cultivation given is shallow, but done at frequent intervals with one-horse implements.

Commercial fertilizers are commonly used for all the general farm crops. Tobacco receives 200 to 500 pounds and cotton 200 to 350 pounds of an 8-2-2 mixture per acre. Corn is fertilized more lightly. Wheat and oats are given about 200 pounds per acre of acid phosphate at the time of seeding. Cottonseed meal is applied with the acid phosphate by some farmers, while others use a top dressing of nitrate of soda.

The present valuation of this land ranges from \$20 to \$50 an acre.

Although not so serious as on the more rolling soils, erosion is in many cases a problem to be reckoned with on this soil. The frequent heavy summer rains rapidly gully a field unless precautions are taken.

#### APPLING STONY SANDY LOAM.

The Appling stony sandy loam consists of a medium to coarse, light-gray to light brownish gray sandy loam of a depth of 6 to 10 inches, underlain by a mottled bright-yellow and red, loose sandy clay which quickly grades into a friable, mottled red, yellow, and gray, compact but brittle clay. Rock fragments, consisting chiefly of granite and quartz, lie thickly over the surface, and bedrock frequently outcrops, often in the form of massive boulders.

This soil is confined principally to the granite belt in the southern part of the county, where it occupies low hills or peaks, narrow ridges, and steep stream slopes. Its topography is accordingly rolling to broken, and drainage is thorough.

The Appling stony sandy loam is of small extent and of little importance agriculturally. It is practically all occupied by a growth consisting principally of pine, oak, hickory, and dogwood. The only practical use that may be made of this type is for forestry, or in some places wooded pasture. Wild honeysuckle grows well and is said to make excellent winter grazing for cattle.

#### APPLING COARSE SANDY LOAM.

The soil of the Appling coarse sandy loam consists of a light brownish gray coarse sandy loam, passing at 3 to 5 inches into a loose, pale-yellow coarse sandy loam. This is underlain at depths ranging from 6 to 15 inches by a mottled red and bright-yellow, loose sandy clay, which grades into a friable clay. Scattered through the type are numerous small knolls and ridges where the surface soil is underlain by the parent rock material, which is disintegrated and partially decomposed. Rock outcrops are more frequent than in the case of the finer-textured soils of the same series.

The organic content of this soil is prevailingly low, but it is easily cultivated and can be safely plowed a few hours after rains.

This type occurs in small, scattered areas throughout the various granite belts, but most extensively through the belt in the southern part of the county. Its topography is prevailingly rolling with occasional steeply rolling to broken areas. Drainage is good to excessive.

This is not an extensive type; it occupies only 2.5 square miles. Probably 40 per cent of its total area is in cultivation. Cotton and tobacco are the cash crops. Enough corn and small grains are usually produced to meet home needs. Soy beans and cowpeas are grown for hay and for seed. Peaches, apples, and other tree fruits, Muscadine grapes, and sorghum, sweet potatoes, Irish potatoes, tomatoes, and

other vegetables are grown for home use. This soil warms up early in the spring, and early crops may be produced. Crops on it are subject to serious damage in protracted droughty spells.

Cotton yields from one-fourth to three-fourths bale per acre, and tobacco from 400 to 600 pounds. Corn yields 10 to 25 bushels, wheat 5 to 10 bushels, and oats 15 to 25 bushels per acre. Soy beans and cowpeas fruit well and produce a good growth of vine. Yields of all crops are low where fertilizer or manure is not used.

Commercial fertilizers are always used for tobacco and cotton, and usually on corn and the small grains. Applications of 200 to 500 pounds per acre are made for tobacco and cotton, and smaller applications for corn.

A ready-mixed fertilizer analyzing 8-2-2 is most commonly used. Wheat and oats are usually fertilized with 200 to 300 pounds of 16 per cent acid phosphate. Nitrate of soda was in general use as a top dressing or side application for growing crops before its present scarcity and high price. Soy beans and cowpeas are grown in rotation with other crops and occasionally turned under to replenish the supply of organic matter.

The present selling value of this land varies from \$20 to \$50 an acre, depending largely upon the location and improvements.

This soil can be improved by the same methods that are suggested for the other members of the Appling series.

The results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Appling coarse sandy loam are given in the following table:

*Mechanical analyses of Appling coarse sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
234615.....	Soil.....	14.7	17.2	6.4	23.3	13.4	21.5	3.6
234616.....	Subsoil.....	18.7	14.2	4.2	13.4	10.1	25.1	14.3
234617.....	Lower subsoil...	21.7	20.0	5.5	13.4	6.9	19.8	12.7

APPLING SANDY LOAM.

Typically the soil of the Appling sandy loam consists of a light-gray to brownish-gray sandy loam which changes to a pale-yellow sandy loam at a depth of 3 to 5 inches. This is underlain at 8 to 14 inches by a bright-yellow sandy clay which quickly grades into a mottled yellow, gray, and red friable clay. In common with other types of mottled subsoil, the lower part of the 3-foot section is extremely variable. Numerous areas are mapped which are made up of alternating patches of soil whose subsoil is either yellow, like that of the Durham series, or red, like that of the Cecil; these patches are so mixed as to prevent their being mapped separately as either Dur-

ham or Cecil, hence they are included with the Appling, which represents a gradation between the two.

This type occurs in small scattered areas throughout the granite belts of the county. Its topography is generally rolling, and drainage is good or even excessive.

This is an inextensive soil, and probably not more than 40 per cent of it is in cultivation. In the southern part of the county cotton is the principal cash crop, and in the northern part tobacco. Sufficient corn, wheat, and oats are generally produced for home needs. Soy beans and cowpeas are widely grown. There are a number of small fields in red clover. Crimson clover and rye are grown by a few of the better farmers as winter cover crops.

Yields of all crops are good in normal years, but are subject to reduction from drought. Tobacco yields from 400 to 600 pounds per acre and cotton from one-third to three-fourths bale per acre. Corn yields from 10 to 30 bushels, wheat 5 to 15 bushels, and oats from 15 to 30 bushels per acre. Soy beans and cowpeas fruit well and produce a good vine.

The methods of fertilizing and handling this soil are the same as those prevailing over the county. It is low in organic matter, but is easily handled and cultivated. Light applications of low-grade fertilizer are generally made.

Present land values on this soil range from \$20 to \$75 an acre, according to the location and improvements.

Owing to its topography, this soil is frequently subjected to serious erosion. Proper terracing, deeper plowing, and the incorporation of more organic matter are its foremost needs.

#### APPLING FINE SANDY LOAM.

The soil of the Appling fine sandy loam consists of a light brownish gray fine sandy loam underlain at about 4 inches by a pale-yellow fine sandy loam. The subsoil, encountered at a depth of 8 to 12 inches, consists of a bright-yellow fine sandy clay which quickly passes into a mottled red, yellow, and gray, friable clay. Small reddish quartz gravel is frequently scattered over the surface, and bed-rock occasionally outcrops, especially on the small knobs and ridges.

This soil occurs in small scattered areas throughout the various granite belts of the county. The largest single area is in the southeastern part between Blackwood School and Mount Moriah Church. The surface is characteristically undulating to gently rolling, and drainage is generally thorough.

This soil is of small extent, but probably 50 per cent of it is in cultivation. It is a good tobacco and cotton soil. Corn and small grains produce well when the soil is kept in a good state of cultivation. Soy beans, cowpeas, and red clover are grown for hay and as soil

improvers. Sorghum grown on this soil produces a sirup of good color and flavor. Peaches and other tree fruits, small fruits, and vegetables are especially successful on this type. Crimson clover and rye are grown to some extent as winter cover crops and for green manuring.

Tobacco yields 400 to 700 pounds, and cotton from one-third to three-fourths bale per acre. Corn yields 10 to 30 bushels, wheat 5 to 15 bushels, and oats 15 to 30 bushels, per acre. Soy beans and cow-peas fruit well and make a good yield of hay.

Commercial fertilizers are generally used on this type. Tobacco receives 200 to 400 pounds per acre and cotton and corn a somewhat lighter application of a ready-mixed fertilizer generally analyzing 8-2-2. The small grains are usually fertilized with 200 pounds of 16 per cent acid phosphate. Nitrate of soda, when procurable, is used to some extent as a top dressing or side application.

The present selling value of this land ranges from \$25 to \$50 an acre, depending upon the location and topography.

#### WILKES COARSE SANDY LOAM.

The surface soil of the Wilkes coarse sandy loam is a light brownish gray coarse sandy loam passing at an average depth of 4 to 6 inches into a pale-yellow coarse sandy loam. The subsoil shows considerable variation. Typically it is encountered at a depth of 6 to 12 inches, and consists of a bright-yellow, loose sandy clay, which at about 20 inches passes into a mottled yellow and gray or yellowish-brown plastic clay. However, there are areas in which the plastic clay subsoil occurs directly below the surface soil; and, on the other hand, small areas in which the subsoil may be typical of the Durham, Appling, or Cecil soils, all so intricately mixed as to prohibit a separate classification. Fragments of aplitic granite, quartz, and diorite often lie scattered over the surface and occasionally outcrop, especially along the steeper slopes.

The Wilkes coarse sandy loam is confined to the northwestern corner of the county. Its topography is rolling, and frequently steeply rolling and broken along the larger stream slopes. The larger areas have a generally ridgy topography. Surface drainage is well established, but owing to the impervious lower subsoil the underdrainage is deficient, resulting in heavy run-off and frequently damaging erosion. In fields in which the depth to the impervious clay subsoil is most shallow, growing crops are liable to damage from either protracted wet or droughty periods.

The Wilkes coarse sandy loam is a comparatively unimportant soil agriculturally. Probably not over 25 per cent of it is in cultivation. The untilled areas support a growth consisting principally of pine, oaks, hickory, cedar, and dogwood.

The deeper soiled areas of most gentle topography have in general been cleared. Tobacco is the leading cash crop. Corn, small grains, soy beans, cowpeas, and red clover are the principal subsistence crops. Sweet potatoes, Irish potatoes, sorghum, and the common garden vegetables are grown for home use. Peaches, apples, and Muscadine grapes are grown in large quantities. Rye, peanuts, crimson clover, vetch, and velvet beans are occasionally grown in a small way.

Tobacco yields from 400 to 800 pounds per acre. Corn yields 15 to 25 bushels, wheat 5 to 15 bushels, and oats 15 to 30 bushels, per acre. Soy beans and cowpeas fruit well and produce a good yield of vine.

Commercial fertilizers are used extensively. From 200 to 500 pounds per acre of ready-mixed goods analyzing generally 8-2-2 is given tobacco. Corn is given 150 to 300 pounds of the same or a lower grade mixture. The small grains are usually fertilized with 200 pounds of acid phosphate. When procurable, nitrate of soda is used as a top dressing or side application. Cowpeas are grown in rotation with the clean-cultivated crops, and occasionally turned under to replenish the supply of organic matter. The organic supply is naturally low, but owing to the loose structure of the soil it is easy to handle with light teams and implements.

The present selling price of this land ranges from \$15 to \$35 an acre, depending upon the location, improvements, and topography.

The recommendations made for the Wilkes sandy loam are applicable to this soil.

#### WILKES SANDY LOAM.

The surface soil of the Wilkes sandy loam consists of a light brownish gray to light-gray sandy loam passing at an average depth of 4 inches into a pale-yellow sandy loam. The subsoil is encountered at a depth of 6 to 12 inches. This lower part of the 3-foot section shows marked variations from place to place. Typically it consists of a bright-yellow, friable sandy clay extending to a depth of 20 inches and passing into a mottled yellow and gray or yellowish-brown, plastic, impervious clay, similar to the subsoil of the Iredell loam. There are spots in which the soil is underlain directly by the plastic clay subsoil, and, on the other hand, small patches where the whole subsoil section resembles that of any of the true granite soils of the county, the Durham, Appling, or Cecil. The Wilkes sandy loam is for the most part derived from aplite or fine-grained binary granite, the variations commonly occurring being due to the presence of typical granites and diorite and diabase dikes.

The Wilkes sandy loam is most extensive in the northern part of the county. There are one or more small areas in the southern part.

The topography is prevailingly rolling, with some steeply rolling and broken slopes along the larger streams. The larger areas have a characteristic ridgy topography. Surface drainage throughout the type is good. Owing to the impervious character of much of the subsoil, the underdrainage is poor, resulting in heavy run-off and frequently in damaging erosion. Crops are subject to damage during periods of either unusually wet or droughty weather.

The Wilkes sandy loam is comparatively inextensive, and probably not over 25 per cent of it is in cultivation. Most of the deeper soiled areas of gentler topography have been cleared. The uncleared areas support a growth of pine, oak, hickory, cedar, and dogwood.

Tobacco is the principal crop on this soil. A small acreage is devoted to cotton. Corn, wheat, oats, soy beans, cowpeas, and red clover are grown for home use on most farms. Among the other crops grown for farm use or for soil improvement are sorghum, sweet potatoes, Irish potatoes, garden vegetables, rye, peanuts, crimson clover, and vetch.

Tobacco yields from 400 to 800 pounds per acre and cotton one-fourth to two-thirds bale. Corn yields 10 to 25 bushels with the ordinary treatment, wheat 5 to 10 bushels, and oats 15 to 30 bushels. Yields of all crops are low where no fertilizer is used.

In its natural condition this soil contains little organic matter. The areas of deeper soil are loose structured and easy to cultivate, requiring only light teams and implements.

Applications of commercial fertilizer generally analyzing 8-2-2 are made for tobacco at the rate of 200 to 600 pounds per acre, and for cotton at the rate of 200 to 300 pounds. Corn is given 150 to 300 pounds of an 8-2-2 or lower grade fertilizer per acre. The small grains are usually fertilized with 200 pounds of acid phosphate. Some farmers use mixed cottonseed meal and acid phosphate with good results. When available, nitrate of soda is generally used as a top dressing or side application for growing crops.

The present selling price of this land ranges from \$15 to \$50 an acre, depending upon the soil structure, the location, the improvements, and the amount of cleared land.

The best means of increasing the productiveness of this soil include primarily terracing, the growing of more legumes, and the turning under of winter cover crops. Many of the steeper slopes should either be reforested or terraced and sown to permanent pasture grasses.

#### WHITE STORE FINE SANDY LOAM.

The surface soil of the White Store fine sandy loam consists of a light brownish gray to light-brown fine sandy loam extending to a depth of 6 to 10 inches. The surface 4 or 5 inches, or the depth to

which the soil is plowed, is commonly darker in color and more open in structure, owing to its greater organic content. The subsoil typically consists of a plastic, impervious clay, dull red in color mottled with gray. Variations in the subsoil color are common, ranging from solid dull red, through red mottled with gray, to gray mottled with red and yellow, or even a dull-yellow color. The subsoil is everywhere plastic. Upon drying out the exposed subsoil cracks in much the same way as joint clay. The depth of the soil also shows considerable variation; in some places there are small galled spots where the soil is a shallow, dull-red loam, while on long gentle slopes and in depressions the sandy covering may have a depth of 12 to 18 inches. On these more nearly level areas the lighter colored subsoil prevails. Along the shoulder of the stream slopes there is frequently a narrow strip of brownish-red fine sandy loam to loam underlain by an Indian-red, friable clay subsoil. These areas are typical of the Penn series, which is of considerable importance in the Middle Atlantic States, but here it occurs in such small areas as not to warrant separate classification. The undecomposed parent-rock material, sandstone, mudstone, and shale, is nowhere more than a few feet from the surface, as is shown in road cuts and by occasional outcrops.

The White Store fine sandy loam is of small extent in Orange County. It occupies the greater part of the low-lying Triassic belt in the extreme southeastern corner. The topography ranges from undulating to gently rolling, and is in places rolling along the larger stream slopes. Surface drainage is good, but the heavy subsoil is almost impervious to the downward passage of water. On the steeper slopes, especially when used for the clean-cultivated crops, the soil has been badly washed when not properly terraced, and in the numerous cases where erosion has not been checked deep gullies have been formed.

Probably 60 per cent of this soil is now in cultivation. The remainder is forested, chiefly with a second growth of rather short pine, oak, and dogwood. As is evidenced by the old corn and cotton beds running through these woods, at least 80 per cent of its area was once under cultivation.

Cotton is the principal cash crop. Corn, wheat, oats, soy beans, and cowpeas are grown, generally in sufficient quantities for home use. On the better areas some red clover is grown, and one small patch of alfalfa was observed. Cotton yields from one-fourth to three-fourths bale per acre, depending upon the fertilization and cultivation and the condition of the land. Corn yields 10 to 20 bushels per acre, wheat 5 to 10 bushels, and oats 20 to 25 bushels. Tree fruits, small fruits, and garden vegetables give satisfactory yields.

Under the prevailing system of farming, this soil is plowed to only a shallow depth, with light one and two horse turning plows. Cultivation is given at frequent intervals, with small one-horse implements, chiefly shovels and sweeps. As yet there has been no general adoption of crop rotations, although the growing of soy beans and cowpeas following the small grains or in the clean-cultivated crops is rapidly being taken up. Commercial fertilizers are quite generally used. Ready-mixed fertilizer analyzing 8-2-2 is generally used, with an occasional 9-2-1 and 10-2-0 mixture. An application of 200 to 400 pounds per acre is generally made for cotton and a smaller one for corn. About 200 pounds of 16 per cent acid phosphate is given to wheat and oats.

This land may be bought at the present time for \$10 to \$40 an acre, according to the location and improvements.

Erosion is a serious factor to be coped with on the White Store fine sandy loam. There should be a more general use of terraces, and slopes that have been allowed to erode should, after being terraced, be sown to one of the various grass mixtures and used for pasture. Erosion would be made less destructive by increasing the supply of organic matter in the soil, through the plowing under of vegetation, such as soy beans, cowpeas, and winter cover crops like rye and crimson clover. More live stock could profitably be kept on this soil, and the manure applied to the land. There are numerous areas lying idle that could well be used for raising beef cattle and sheep. Bermuda grass, Japan clover, and in the low places various moisture-loving grasses afford excellent pasturage from spring to fall, while soy beans, cowpeas, vetch, oats, sorghum, and other forage crops can be grown for roughage and corn for silage.

The liberal incorporation of vegetable matter and manure, along with applications of acid phosphate, and deep preparation of the seed bed would have a much more permanent effect upon the soil than the application of commercial fertilizer.

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

*Mechanical analyses of White Store fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
234608.....	Soil.....	0.7	4.8	7.3	40.0	24.7	19.7	2.8
234609.....	Subsoil.....	.0	1.0	1.2	8.7	10.7	26.9	51.6

GRANVILLE FINE SANDY LOAM.

The surface soil of the Granville fine sandy loam is a light brownish gray to grayish-brown fine sandy loam grading into a pale-yellow fine sandy loam at 3 to 5 inches. This is underlain at a depth of 10 to 14 inches by a bright-yellow friable sandy clay which

becomes heavier with depth, and frequently changes to a mottled yellow and gray or dull-red rather sticky clay at about 30 inches.

The content of organic matter is rather low in the virgin soil. In cultivated fields, where vegetable matter has been worked into the soil, its upper section has a brownish color.

The Granville fine sandy loam occurs in a few small, scattered areas through the low Triassic belt in the southeastern part of the county. Its total area is small. The topography is characteristically gently undulating to nearly level, but drainage is usually sufficient. The area bordering Booker Creek, especially where it is crossed by the Chapel Hill-Durham Road, has the general appearance of an old eroded terrace.

Probably 60 per cent of the type is in cultivation. Both cotton and tobacco are grown as cash crops. Corn, wheat, oats, soy beans, cowpeas, sorghum, and all the vegetables common to this section are successful. Except in local poorly drained spots, this soil is well adapted to early planting. The methods of fertilization and cultivation are identical with those on the other sandy types of the county. Under proper handling all crops produce well.

The present valuation of this type ranges from \$20 to \$40 an acre.

To keep this soil in a productive condition, the legumes such as soy beans and cowpeas, should be grown in rotation with the clean-cultivated crops, and the supply of organic matter should be augmented by plowing under stable manure and occasional crops of crimson clover or rye. Good yields can be obtained by simply applying high-grade fertilizers in liberal quantities, but this method is less profitable and less likely to effect permanent improvement of the soil.

Mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Granville fine sandy loam gave the following results:

*Mechanical analyses of Granville fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
234610.....	Soil.....	1.9	6.7	6.1	31.0	23.6	29.8	1.2
234611.....	Subsoil.....	1.3	6.4	6.3	28.5	18.0	30.1	9.7
234612.....	Lower subsoil...	1.2	4.8	5.6	22.5	14.2	28.6	23.4

CONGAREE SILT LOAM.

The surface soil of the Congaree silt loam in its typical development consists of a brown silt loam from 10 to 15 inches deep. The subsoil shows no marked change in the upper section but gradually becomes a light-brown, compact, heavy yet friable silty clay loam to silty clay, often slightly mottled with gray. Small flakes of mica occur through the soil and subsoil section.

All the first bottom areas in the county are included in this type, hence there are naturally considerable variations from the typical. Probably the most important of these are the wider bottoms along lower Bolin Creek and Booker Creek, and along Little Creek at their confluence. These wider areas are flat and comparatively low, and the soil is prevailingly a silty clay loam. In an area along the bend in Morgan Creek about one mile west of where it crosses the Durham County line, the soil is typical Congaree sandy loam. Bordering Haw River, along the southwest corner of the county, the soil approximates the Congaree fine sandy loam. Included with the type are small scattered depressions, particularly near the streams in the wider bottoms, where the surface soil is a grayish silt loam underlain by a mottled drab and brown silty clay subsoil. These areas are typical of the Wehadkee silt loam, but they do not occupy a total area of sufficient size to warrant separate mapping.

The Congaree silt loam occurs in narrow, interrupted first-bottom areas along the various streams of the county. Its surface is level or nearly so. All the type is subject to inundation, but between overflows most of it is well drained. Some of the included low areas are poorly drained.

This type is not extensive, but most of it is cleared. The remainder is forested largely with water oak, willow oak, hickory, sweet gum, birch, poplar, and willow.

Most of the type along the smaller streams and branches is used as native hay or pasture land. The larger areas are generally in cultivation, while the occasional depressed spots are used for hay production. Corn is the principal crop. Cotton, small grains, and legumes are grown on the higher, better drained areas.

Yields vary with the seasonal conditions, being lowered by late, wet springs and occasionally by overflows. Corn yields from 15 to 40 bushels per acre and occasionally more. Cotton yields from one-third to 1 bale, wheat 10 to 25 bushels, oats 20 to 40 bushels, and the legumes from  $\frac{1}{2}$  ton to  $1\frac{1}{2}$  tons of hay, per acre.

This soil is mellow and easily tilled. It is frequently plowed deeper and handled better than the upland soils. Very little fertilizer is used.

#### SUMMARY.

Orange County is situated in the central-northern part of North Carolina, in the second tier of counties from the Virginia State line. It has an area of 400 square miles, or 256,000 acres.

This county lies in the Piedmont Plateau region. The elevation ranges from 500 or 600 feet throughout the greater part of the county to 250 to 400 feet above sea level in the southeastern corner. The topography is prevailingly rolling to hilly.

Orange County was organized in 1752. In 1910 the population amounted to 15,064, all of which is classed by the census as rural. Two-thirds of the population is white.<sup>6</sup>

Hillsboro, the county seat, had a population of 857 in 1910. The State university is located at Chapel Hill, which is the largest town, with a population of 1,149 in 1910.

The Southern Railroad traverses the county through the central part, east and west. There are a number of graded and surfaced highways in the county, but in general the public-road system could be much improved.

The climate of this region is mild and healthful. Cover crops and a number of vegetables can be grown throughout the winter. The rainfall is ample and well disturbed. There is a normal growing season of about 200 days.

Agriculture has been the leading industry of the county since the first settlement. Manufacturing is of some importance.

Tobacco and cotton are the principal sources of income. Corn is more widely grown than any other crop, followed by wheat and oats. Hay and forage crops are grown more extensively each year.

The minor crops of the county are sweet potatoes, Irish potatoes, soy beans, cowpeas, red clover, crimson clover, sorghum, peanuts, watermelons, cantaloupes, apples, peaches, cherries, plums, and Muscadine grapes, together with a variety of garden vegetables.

There are a large number of soils in the county, but these can be grouped into three classes, viz, light-colored sandy surface soils, heavy red soils, and gray to red, silt or floury-textured soils.

The well-drained soils of the Durham, Appling, White Store, and Granville series are particularly well adapted to the production of bright tobacco.

The heavy red lands, particularly the Davidson clay loam and a portion of the Georgeville silt loam and the Cecil clay loam, are well suited to the growing of grains, grasses, clovers, and other leguminous crops. They are the best corn, wheat, oat, and clover soils in the county. Some of the more rolling and broken areas, and also the stony types, can best be used for pasturage or for permanent forestry.

The alluvial or first-bottom soil along the streams, mapped as Congaree silt loam, is especially suited to the growing of corn and grasses, and excellent yields are obtained without the use of commercial fertilizers.

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<sup>6</sup> See footnote on page 223.

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