Issued July 24, 1914.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE FLORIDA STATE GEOLOGICAL SURVEY;
E. H. SELLARDS, STATE GEOLOGIST.

SOIL SURVEY OF BRADFORD COUNTY, FLORIDA.

BY

W. C. BYERS, ARTHUR E. TAYLOR, J. B. R. DICKEY,
AND N. M. KIRK.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1913.]

WASHINGTON:
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1914.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., February 12, 1914.

SIR: The accompanying report and soil map cover the survey of Bradford County, Florida, one of the projects undertaken by the bureau during the field season of 1913. This work was carried on in cooperation with the Florida State Geological Survey, and the selection of this area was made after conference with the State officials.

I recommend that the report and map covering this work be published as advance sheets of Field Operations of the Bureau of Soils for 1913, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

Soil map, Bradford County sheet, Florida.

SOIL SURVEY OF BRADFORD COUNTY, FLORIDA.

By W. C. BYERS, ARTHUR E. TAYLOR, J. B. R. DICKEY, and N. M. KIRK.

DESCRIPTION OF THE AREA.

Bradford County lies in the northeastern part of Florida. It is irregular in shape and is bounded on the north by Baker County, on the east by Clay County, on the south by Alachua County, from which it is separated by Santa Fe Lake and the Santa Fe River, and on the west by Columbia County, the western boundary being formed by Olustee Creek. The county has a maximum width of about 30 miles from north to south, and a length of 32 miles from east to west. It has a total area of 539 square miles, or 344,960 acres.

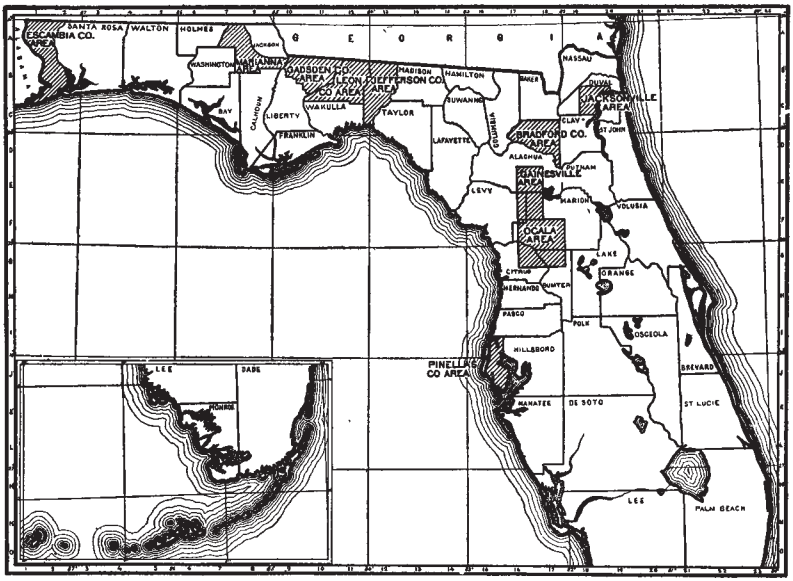

FIG. 1.—Sketch map showing areas surveyed in Florida.

Bradford County lies wholly within the Coastal Plain. The divide between the Gulf and the Atlantic Ocean is just a few miles east of the east county line, swinging around a few miles north of the north county line. The range in elevation within the county is about 140 feet, or from about 60 to approximately 200 feet above tide. The drainage is toward the south and west. The county is drained by the Santa Fe River and its tributaries, including mainly Alligator Creek, Sampson River, New River, and Olustee Creek, with their

numerous branches. All of these streams flow in either a southern, western, or southwestern direction.

Some sections of the county have well-defined drainage systems. Much of the flat country, however, is inundated during seasons of heavy rainfall, and cypress ponds, bays, and swamps remain filled with water for long periods.

The northern and eastern parts of the county lie almost entirely within the flatwoods region. The topography of this section is flat to gently undulating, with but a few slight surface variations. As the larger streams are approached the surface becomes gradually more undulating and in places even rolling to hillocky, with relatively deep, narrow, well-defined valleys. The highest elevations are in the northeastern part of the county. The country along the larger streams, notably the Santa Fe River, the New River, Olustee Creek, and Swifts Creek near its confluence with Olustee, has a more rolling topography, including ridges which in places terminate with a bluff along the streams. In this section the valleys are narrow, and the numerous smaller streams or "branches" which work back into the uplands from the larger streams give the country a decidedly billowy surface.

Farther back from the larger streams, beyond the heads of the tributary streams, the country has a more nearly level topography, difference in elevation between the stream courses and the crests of the divides being barely perceptible. As this country is approached the floors of the stream valleys rise gently until they approach the general level of the upland, their power of erosion lessening until they become almost negligible in altering the level topography. The stream valleys are therefore shallow, and it is difficult in many cases to determine the extent of the overflow land, owing to the gradual merging of the bottoms into the upland. In some cases the prevailing surface has so slight an elevation above that of the stream courses that the water spreads out from the stream channels in places over large expanses of the surrounding country, forming "swamps" which support a luxuriant growth of subtropical water-loving vegetation. With but few exceptions, the stream channels are not well defined, and frequently a stream course has two or more channels, while during seasons of protracted rainfall the water covers the entire valley floor. The streams generally head in "bays" or swamps and in their upper reaches are merely drainage ways or wet-weather streams.

Bradford County was formed from Alachua and Columbia Counties in 1858. It was originally known as New River County, the name being changed to Bradford County in 1861. The county seat was moved from Lake Butler to Starke in 1887.

The population of Bradford County in 1890 was 7,516, in 1900, 10,295, and in 1910, 14,090. Starke, with a population of 1,135, is the largest town in the county. It is situated on the Seaboard Air Line Railway in the eastern part of the county, and about 45 miles from Jacksonville. It is one of the most important points of strawberry shipment in the State. Lake Butler, the former county seat, is situated near the center of the county. Its population is given in the 1910 census as 685. Is is also an important shipping point, owing to its location on both the Atlantic Coast Line and Georgia Southern & Florida Railroads. Lawtey, with a population of about 500, is on the Seaboard Air Line Railway in the northeastern part of the county. Considerable shipments of strawberries take place at this town. Hampton, on the Seaboard Air Line and Georgia Southern & Florida Railroads; Raiford and Worthington, on the Atlantic Coast Line; and Brooker, on the Wannee Branch of the Seaboard, are towns of less importance.

Bradford County is well supplied with means of transportation. The main line of the Seaboard Air Line runs north and south through the eastern part of the county. The Atlantic Coast Line traverses the county from the north-central to the southwestern part. The Georgia Southern & Florida runs diagonally across the county from northwest to southeast, and the Wannee Branch of the Seaboard Air Line extends southwest from Starke, terminating in the adjoining county. The Tampa & Jacksonville Railway runs south from Sampson.

Wagon roads are numerous and extend into all parts of the county, but are generally unimproved.

CLIMATE.

The climate of Bradford County is practically subtropical. The winters are short and mild and the summers long and hot. December, January, and February are the coldest months, and for this period the temperature averages about 56° F. The coldest weather is usually in February. There are sometimes traces of snow, though measurable quantities are practically unknown. Usually the cold weather comes in periods of two or three days' duration, followed by as many days of clear, warm weather, which generally precedes rain. Owing to the high humidity, the cold is penetrating.

July and August are the hottest months, with a mean temperature of about 81° F., but extremely high temperature is rare, and the heat is moderated by breezes which are practically continuous.

The rainfall, which is ordinarily sufficient for crop growth, is well distributed throughout the year. However, during seasons of scant rainfall crops grown upon the more sandy and better drained soils

are likely to suffer from drought, while during seasons of excessive precipitation an excess of water frequently collects on the lower lying and poorer drained areas and is decidedly detrimental to plant growth.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation recorded at the Weather Bureau station at Gainesville, Alachua County, Fla. In the absence of local records, these figures, compiled from data recorded at a point only a short distance to the southwest, are fairly representative of conditions in Bradford County.

Normal monthly, seasonal, and annual temperature and precipitation at Gainesville, Alachua County, Fla.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	56.6	85	19	2.74	1.15	5.61
January	54.9	89	16	3.28	3.81	8.18
February	57.1	87	6	3.28	4.15	6.90
Winter	56.2	.....	.....	9.30	9.11	20.69
March	64.6	96	25	3.44	.83	3.75
April	68.5	95	38	2.36	.14	.27
May	75.8	99	47	3.79	1.75	6.63
Spring	69.6	.....	.....	9.59	2.72	10.65
June	80.3	102	58	7.44	2.43	11.45
July	81.4	102	60	7.48	6.89	5.91
August	81.2	99	64	7.03	7.69	10.23
Summer	81.0	.....	.....	21.95	17.01	27.59
September	78.0	99	48	5.86	3.98	11.62
October	70.4	95	36	2.54	1.76	4.77
November	62.5	90	22	2.10	.57	1.41
Fall	70.3	.....	.....	10.50	6.31	17.80
Year	69.3	102	6	51.34	35.15	76.73

The date of the last killing frost recorded in the spring is March 21, and of the first in the fall, November 13. The average date of the last killing frost in the spring is February 20, and of the first in the fall, December 11.

Plowing and other farm operations can be readily carried on throughout the year, especially on the better drained soils. Flowers bloom during the whole year, and the more hardy vegetables grow unprotected during the winter months.

AGRICULTURE.

Little attention was given to agriculture by the early settlers in this region. The western part of the county was the first to be settled. About 1835 several families came to that section of the county in which Providence is now located and engaged in stock raising. Settlement extended into the eastern part of the county a few years later.

Cattle and hogs could live on the open range without feeding and with little attention the entire year, and it was natural that stock raising should have first claimed the efforts of the settlers and should have continued to be for some years the most important industry of the county. Small areas were cleared around the buildings, and vegetables and corn in sufficient quantities for home use were produced.

It was not until about 1855 that cotton became important. Large plantations throughout Bradford County were devoted mainly to this crop, and with its development the increasing demand for corn to feed farm stock and to supply home needs resulted in an extension of the corn crop. Agricultural progress was retarded by the Civil War, and immigration, which had been steady up to this time, was stopped. After the Civil War the agricultural development of the county was slow, and only within comparatively recent years have the resources of the county begun to be developed along broad lines. There are but few farms in the county outside of the western section that have been under cultivation for a long period of years.

Lumbering and turpentining became important about 1880. Both of these industries were developed at the expense of agriculture, although they were instrumental in clearing the land for future agricultural pursuits. At present lumbering and turpentining are the most important industries in the county. A great deal of the merchantable timber has been removed, and most of the remaining trees are "boxed" for turpentine. One large plant for the extraction of turpentine and other pine products from logs and stumps is in operation at Lake Butler. The stumps and resinous logs are being removed from land in that section of the county without expense to the owner.

About 1880 agriculture again came into importance in the county. Settlers came in from Georgia, the Carolinas, Mississippi, Kentucky, Virginia, and in some cases from as far north as Pennsylvania. Oranges were being grown extensively at this time, and a few years later strawberry growing began. The strawberries were produced for early shipment to northern markets, and the fancy prices that were obtained encouraged the extension of this industry. The culture of strawberries soon became general, and this crop rivaled oranges for the place of first importance in the agriculture of the county. In the

meantime cotton, corn, and cattle had been the principal sources of income on many farms, and at present these are produced extensively, though of late years cotton has declined in importance.

Agriculture received its second reverse during the winter of 1894–95, when practically all of the orange trees in the county were killed by frost. Though not entirely dependent upon oranges as a cash crop, it was one of the main sources of support of many farmers, and the destruction of the groves resulted in great financial loss. Orange production has never resumed its place of importance in the agriculture of the county, but in all sections young trees are growing and are apparently in a healthy condition. In most cases the trees have grown from the roots of those killed by frost, though in some instances new trees have been set out. While a large number of farmers have small groves, comprising in places as many as 20 or 30 trees, to produce oranges for home or local use, the only commercial orchard where oranges are packed for shipment is in the southern part of the county near Sampson.

Strawberries have steadily grown in importance, and at present this crop forms the basis of a very large industry in the eastern part of the county. While small quantities are shipped from Lake Butler, Raiford, and several of the smaller towns, Starke and Lawtey are the centers of the berry industry. The census for 1910 gives the total value of fruits and nuts, including small fruits, produced in Bradford County in 1909 as $152,568. Since the amount of large fruits and nuts shipped from the county is practically negligible, this total amount represents the value of the berry crop. Within the last few years the strawberry industry has developed still further. According to the 1910 census, 1,353,822 quarts of strawberries were produced from a total of 699 acres in 1909.

Corn occupies the largest acreage of all the crops in the county. According to the census for 1880, less than 10,000 acres were devoted to this crop in 1879, while in 1909 a little less than 21,000 acres were used for corn production. In growing this crop the land is plowed at any time between November and February. The depth of plowing varies from 4 to 8 or more inches. Some farmers plow to a depth of about 8 inches and follow the plow with a subsoiler, which breaks the land several inches deeper without turning any of the subsoil to the surface. Deep plowing as early in the fall as possible results in increased yields, and is effective in conserving a maximum amount of the winter rainfall for the use of growing crops. Corn is usually planted between the middle of March and the first of April and is harvested late in August or early in September.

There is no system of rotation in general practice in the county, and corn often follows corn on the same land for a number of years. The yield is better when corn follows sugar cane, cowpeas, velvet

beans, or peanuts than when grown after cotton or when corn has occupied the same land for several successive years.

Little or no attention is paid to seed selection, nor is any effort made to secure seed of better varieties. The "frenching" of corn has caused considerable loss during recent years. This disease attacks the corn in an entire field or a part of the field and completely destroys the crop in a very short time. It usually appears in April, and is first noticed when the corn turns pale yellow and white and the leaves begin to wilt. In its more advanced stages the roots become black, and the plant dies very much as a cowpea or cotton plant affected with "wilt." The disease is particularly prevalent over land of low fertility, and attacks crops on the well-drained sandy soils as well as upon the moister flatwoods types.

The corn land is fertilized, largely with commercial fertilizers. The available stable manure is also used. The usual corn fertilizer contains 8 per cent of phosphoric acid, 2 to 2½ per cent of nitrogen, and 2 to 3 per cent of potash. This mixture is applied at the rate of about 200 pounds per acre. Through the systematic rotation of crops, the incorporation of organic matter in the soil by plowing under green crops, and through deep plowing, some farmers have been able to reduce their fertilizer bill and at the same time secure larger yields.

Corn yields range from 5 to 35 bushels per acre, depending largely upon the method of cultivation and the treatment of the soil. Fifteen bushels is about the average yield for all of the soil in the county.

Next in importance to corn in acreage is cotton. Sea-island, or long-staple, cotton is produced exclusively, the climate being unsuited to the short-staple varieties. The 1910 census reports a total of 12,795 acres devoted to this crop, with a production of 2,998 bales in 1909. While the acreage of cotton has increased, the farmers are less dependent upon this crop as a sole means of support, there being other important cash crops, chief among which are strawberries. Cotton is grown on practically all of the upland soils, but is most productive on the Norfolk soils in the western and southwestern parts of the county.

No system of rotation is practiced wherein cotton has a place, and consequently the soils are not being improved. Large applications of fertilizers containing about 10 per cent of phosphoric acid, 2 per cent nitrogen, and 3 per cent potash are used. After cotton has followed cotton for a number of years, the land is usually put in corn for an equal period, or corn and cotton are grown alternately. When cotton follows corn, the crop does best where the soil is not disturbed below the depth of planting. The hot winds and heavy rains in July are considered the most harmful incidents in cotton production. These, it is claimed, cause the cotton to shed a portion

of the young bolls, and no fertilization or cultural method has been found to enable the plant to avoid this loss. Cotton is usually planted between March 15 and April 1. The scarcity of labor and the high price demanded for picking are serious obstacles to cotton production in the county.

Cowpeas, velvet beans, and peanuts are grown extensively for forage. One or two of these legumes is usually planted in corn for use as pasture after the corn has been harvested. In this way a large amount of feed is secured for cattle and hogs during the late fall and early winter. Cowpeas and velvet beans are also grown for hay, and both make a luxuriant growth, though difficulty is often encountered in curing the pea-vine hay. The velvet beans make a more certain crop, and the vines are more easily cured. Peanuts are grown largely for hog feed or to be plowed under. The planting of a legume in corn after the last cultivation is not generally successful, and a more common and surer method is to plant such a crop with the corn. One plan that has been found profitable is to plant the corn in rows about 9 feet apart, with a row of peanuts between the corn rows. Among the peanuts velvet beans are planted in hills 6 feet apart in the row. After the corn is harvested a heavy growth of beans and peanuts furnishes an abundance of good feed for fattening cattle and hogs.

Oats are grown extensively in the county, largely for hay. Where allowed to ripen the yield of grain is about 15 bushels per acre. Various cultural methods are practiced. On wet areas the oats are sometimes drilled in rows, which are slightly ridged to afford better surface drainage. Sometimes they are sown broadcast on beds which rise above the general level of the field. On the better drained areas the oats are sown broadcast. This crop is one of the main sources of hay. It is grown by nearly all of the farmers and is cut just before the grain ripens.

A small amount of rye is also grown in much the same manner as oats, and cut for hay. Millet has recently been introduced. This crop makes a rank growth and affords an abundance of forage. Beggarweed hay is also an important forage crop, and the larger part of it is obtained from land that has already grown some other crop. Beggarweed is self-sown.

Sugar cane was one of the early crops of the county, and is still of considerable importance. Although not grown commercially, a patch is grown by nearly every farmer for the manufacture of sirup for home consumption. The varieties grown are the Red, Large Green, Cuba, White, and Ribbon. There is little noticeable difference between the several varieties, although the Red and Cuba are probably the most popular. Rice was formerly grown on a small scale, and is said to have produced an average yield of about 15 bushels

per acre. The decline in its production was due to the appearance of a blight. A variety of upland rice is still grown, though the acreage is decidedly small.

Sweet potatoes are grown for home use, but have never been important commercially. They are produced on all the upland soils in the county, the yields averaging about 200 bushels per acre. Irish potatoes are grown on a small scale. Although large yields are secured, the production of this crop has never been extended to any great extent. Irish potatoes do exceptionally well on the Portsmouth fine sandy loam, the soil upon which the potato industry has been extensively developed in other localities. The crop also does well on the Norfolk soils, the Coxville fine sandy loam, and the Portsmouth fine sand. Potatoes may be planted in January, although the general practice is to plant about February 1. The early plantings are harvested in May and the later plantings and later varieties in June. The crop is usually planted on ridges in soil plowed about 3 inches deep, the seed bed having been prepared in November. The potato beetle, which does so much damage to the crop in other localities, is unknown here, but potato "wilt," or "blight," is sometimes destructive where spraying is not practiced.

More money is brought into the county from the production of strawberries than from any other agricultural source. Berries begin to ripen some seasons as early as the first of January, though shipment does not begin until February. The season is at its height during March and early April. Naturally the early shipments command the highest prices. The smaller shipments usually go in small refrigerator boxes, which are iced at starting and at various places en route in ordinary express cars. The later and larger shipments consist of carload lots, principally to Philadelphia, New York, and Boston, though some go even farther. Commission houses from the northern cities send buyers to both Starke and Lawtey, where they remain during the entire season, and either buy the berries at the cars or solicit shipments to the firms they represent for sale on commission. Seven or eight cars a day are not unusual shipments from Starke in midseason, while Lawtey sends almost as many.

Several varieties of berries are grown, though the Klondike and Missionary are by far the most popular. The Lady Thompson and Brandywine are also grown. The Missionary is a little earlier than the other varieties. The fields are prepared in slightly elevated beds, which are wide enough to accommodate two rows. The young plants which are set out for the main crop are obtained from runners set out in March or April. The main crop is set out at any time from July to October. High-grade commercial fertilizers are applied when the plants are set and at two other periods during the growth of the crop. In all, from one-half to 1 ton of fertilizer is applied to the acre. The

first application usually consists of about 200 pounds. The second application is usually made in November. At this time the beds are "barred off" by plowing a shallow furrow away from the plants, but as close up to them as it is possible to run the plow without injuring the young roots. Into this furrow, which is made along only one side of the row, the fertilizer is dropped. A week later the other side of the row is treated in the same way. The last fertilization is made in January or February between the rows, from 200 pounds to 400 pounds of a mixture usually richer in potash than the mixtures formerly used being applied.

The yield and quality of the berries are mainly dependent upon the season. In seasons when the rainfall is heavy during the ripening period the berries are soft and arrive at the market in poor condition, even though comparatively large. The price received for the berries varies from $2 to $12 per crate and averages about $3.

The production of beef cattle seems to offer attractive opportunities in Bradford County. Herds of varying size are pastured over large areas of woodland, living entirely in the open and upon the native vegetation, principally wire grass. With but little effort Bermuda grass, St. Augustine grass, lespedeza (Japan clover), and Johnson grass can be grown and permanent pastures of succulent forage established. The cattle receive but little attention. The animals pastured in the woods are usually infested with ticks, and not infrequently large numbers die as a result. Those that are properly cared for and kept from the woods are comparatively free from ticks. The cattle are not dipped. Native cattle are valued at about $10 to $12 per head. Little attempt has been made to improve the breed. A few small herds of goats are kept.

Unlike almost all the other farm animals, the hogs in the county are of improved breeds, and though crosses are usually seen the typical "razorback" is uncommon.

Mules are used largely in farm work and lumbering and are of good size and quality. Horses are sometimes used for farm work, and oxen are used to a small extent in lumbering, but seldom in farming. Most of the work animals are shipped into the county.

In 1879 there were 689 farms in Bradford County, with a total of 67,572 acres, of which 22,470 acres were improved. According to the 1910 census there were 134,884 acres in farms in 1909, of which 54,255 acres were improved. The average size of farms has decreased from a little less than 100 acres in 1879 to about 85 acres in 1909, and this reduction is due largely to more intensive farming, or the change from cotton and corn farming to trucking and the production of strawberries. Only about 40 per cent of the land of Bradford County is farmed. In 1879, 594 farms were cultivated by the owners. Of the remainder, 41 were rented for cash and 54 for a share of the prod-

ucts. In 1909, 1,126 of the 1,587 farms were operated by the owners, 455 by tenants, and the remainder by managers. About two-thirds of the tenants rent for a share of the products and the remainder largely for cash. The value of farm implements used in the county has increased from $11,982 in 1879 to $105,764 in 1909.

The county seems to be in a transitional stage of development. The lumber and turpentine are nearing exhaustion, and signs of a new agriculture are in evidence in the clearing of land and the use of improved implements.

The greatest opportunity for agricultural improvement in the county is along the line of drainage. Almost all sections of the county are capable of either ditching or tiling and could, with comparatively little cost, be converted into land suitable for intensive agriculture. A general system of drainage is being inaugurated in the county, and should mark the beginning of a larger development along agricultural lines.

SOILS.

Bradford County lies wholly within the Coastal Plain, and its soils, with the exception of those which occupy the flood plain of streams or occur around some of the lakes and the Peat and Muck beds, are derived from old marine sediments. Since the elevation of the region above sea level, weathering has effected some changes in the deposits, and erosion has in places altered the original surface configuration.

The numerous sink holes in the southwestern part of the county are attributed to the solution and caving in of the underlying Vicksburg limestone. Although this limestone occurs beneath the whole county, it is too deep to have contributed any material to the formation of the soils, and is important only as it has influenced the topography and altered the drainage conditions.

Covering the limestone are unconsolidated deposits of varying thickness. A very close relationship exists between the nature of these underlying beds and the soils derived from them. Where the parent formation is a deep sand bed, naturally the resulting soil is a sand, and where the particles in the original formation are fine the soil derived from it is correspondingly fine in texture. The more clayey beds give rise to the sandy loams and fine sandy loams, the texture depending on the predominance of one or the other grade of included sand.

The soils of the county fall into three broad groups, according to their origin and mode of formation. They are sedimentary—and this group comprises the greater part of the area—alluvial, and cumulose. Each of these broad groups is subdivided into series and types. The series include soils of similar derivation, color, drainage, topography, and character of subsoil.

The type differentiation within any series is based entirely upon the texture or relative proportion of soil particles of the different grades or sizes. There are 5 series and 10 types of soils in the sedimentary group, 1 series of 2 types in the alluvial group, and 2 types in the cumulose group. The Norfolk, Leon, Scranton, Coxville, and Portsmouth series are in the first group and the Johnston in the second.

The soils of the Norfolk series cover 19 per cent of the area of the county. These soils are not widely distributed, being confined to those parts of the county having the strongest relief and best drainage, where oxidation has been able to extend into the subsoil. The larger bodies occupy the rolling country adjoining the larger streams or lakes. The soils are also found in small, elevated areas within the low-lying flatwoods section.

The Leon series is similar to the Norfolk in derivation, differing mainly in the presence of a hardpan stratum within the 3-foot profile. A relatively small area of one type is found in the county. It occupies the slightly elevated divides between streams in the flatwoods country. This soil is apparently about as well drained as the Norfolk soils.

The soil of the Scranton series is intermediate between the well-drained Norfolk soils and the poorly drained Portsmouth soils. It is represented by the fine sandy loam type, which is not extensively developed.

The soil of the Coxville series is represented by one type confined almost wholly to the north-central part of the county and occupying the long, slightly elevated ridge on the west side of New River, where it enters the county. Smaller, isolated areas occur in other sections of the county, always at a slightly higher elevation than the surrounding country. Insufficient drainage seems to have prevented complete oxidation of the subsoil material, as indicated by the mottled yellow, gray, and red color.

The Portsmouth series occupies the poorest drained part of the upland, comprising the low, flat country known as the "flatwoods." The soils are more widely distributed than those of any other series, and their total area is 59.6 per cent of the area of the county.

A conspicuous feature of the Portsmouth fine sand, Leon fine sand, and Portsmouth sand is the reddish-brown or dark-brown, somewhat compact layer of material, commonly called "hardpan," encountered at depths varying from a few inches to about 24 inches beneath the surface. This layer usually averages about 6 inches in thickness, although the underlying material is often discolored from leaching to a considerable depth. The position in the soil section that the hardpan layer occupies is at or near the place where the ground water

stands the greater part of the year. The manner of formation of the layer is not definitely known, though the fact that it contains a large amount of organic matter would seem to indicate that organic compounds and some iron salts have been carried down in solution and precipitated at the place where the ground water usually stands or that fine particles of organic matter were carried down and fixed by filtration or some other process near the average level of the water table. In laboratory examination the material burns to a white fine sand, the small lumps quickly falling apart as the organic matter is burned out.

In the alluvial group in Bradford County are found two types of the Johnston series, which form 4.4 per cent of the area of the county. The types are found in all parts of the county.

Muck and Peat occupy considerable areas in the county, there being 41 square miles of the former and 22.1 square miles of the latter. The peculiarities of these types, as well as of the other series and types, will be discussed in detail in following pages. The names and extent of the several soils are shown in the following table, and their distribution is brought out by means of colors on the accompanying map.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Portsmouth fine sand	135,680	39.3	Norfolk loamy sand	9,984	3.0
Portsmouth fine sandy loam	48,448	14.0	Johnston fine sandy loam	9,472	2.7
Norfolk fine sand	35,136	10.2	Norfolk sand	6,848	2.0
Muck	26,240	7.6	Johnston fine sand	5,824	1.7
Portsmouth sand	21,760	6.3	Scranton fine sandy loam	4,544	1.3
Peat	14,144	4.1	Coxville fine sandy loam	2,112	.6
Norfolk fine sandy loam	12,992	3.8			
Leon fine sand	11,776	3.4	Total	344,960	.....

GRAY SOILS.

SEDIMENTARY MATERIAL—SANDS AND CLAYS.

NORFOLK SERIES.

The Norfolk soils are characterized by the light-gray to grayish-yellow color of the surface soils, and by the yellow color and friable structure of the sand or sandy clay subsoils. They occupy nearly level to rolling uplands throughout the Coastal Plain and have been derived from marine sediments. The lighter members of this series are used for the production of early, medium, and late truck crops, and the heavier members for growing cotton, corn, and other general farm crops. In Florida certain of the types are used in growing citrus fruits. The sandy members predominate.

NORFOLK SAND.

The Norfolk sand consists of a gray or slightly brownish gray loose sand, underlain at about 5 to 8 inches by a gray, grayish-yellow or pale-yellow incoherent sand extending to a depth of 3 feet or more. In the lower part of the 3-foot section the material usually has a lighter color than the upper subsoil, especially in the lower lying, poorer drained situations.

In the lower situations, where the Norfolk sand grades into the Portsmouth soils, the surface soil is darker in color, usually a dark gray to grayish brown. The texture of the Norfolk sand varies somewhat. In places quartz fragments of the size of buckshot are encountered. In other places the type contains large quantities of fine sand.

The type occurs on slight elevations within bodies of Portsmouth soils. The largest areas are in the southern part of the county between the Santa Fe and New Rivers, and on the higher elevations above the Santa Fe River near Worthington. One area is developed in the northeastern part of the county near Highland, on the elevation which forms the divide between the Gulf of Mexico and the Atlantic Ocean.

The Norfolk sand was originally forested with longleaf pine, live oak, water oak, blackjack oak, and turkey oak. It supports a scant growth of wire grass.

Very little of the type is under cultivation. It is so thoroughly drained that crops are likely to suffer from drought even during ordinary periods of dry weather. The nature of the soil is such that with continuous cultivation the supply of organic matter becomes depleted unless special care is taken to maintain the supply by plowing under green crops frequently. The incorporation of humus in the soil increases its water-holding capacity and renders it less susceptible to drought. As a whole the type is easily handled. It can usually be plowed within a few hours after a heavy rain. It is adapted to early truck crops, but is used locally for the general farm crops.

NORFOLK FINE SAND.

The Norfolk fine sand consists of a gray or pale yellowish gray to dark-gray, rather loose, incoherent fine sand, underlain at about 5 to 8 inches by a yellow, pale-yellow, or grayish-yellow fine sand, extending to a depth of more than 3 feet. Like the surface soil, the subsoil is decidedly incoherent and the texture is often modified by the presence of larger particles, which occasionally attain the size of buckshot or small peas.

Variations from the typical soil are encountered where the type grades into other soils. Where the Norfolk fine sand passes into the

Portsmouth fine sand the surface soil becomes darker in color because of the larger humus content, and the subsoil in its upper part is a dingy or dull yellowish-gray, appearing as though the hardpan layer found in the Leon soils at one time might have been present. The lower subsoil in such situations is grayish yellow or pale yellow.

Where the Norfolk fine sand grades into the Leon fine sand the surface soil of the former is grayish white, the subsoil having the dingy yellowish-gray color shown where it approaches the Portsmouth fine sand. In other areas the subsoil may incline more toward a whitish gray than is typical.

The surface soil of the Norfolk fine sand differs from that of the Portsmouth fine sand in that its organic-matter content is decidedly smaller, which causes the color to be lighter. The subsoil of the Norfolk fine sand is yellow, while that of the Portsmouth fine sand is white and usually includes a hardpan layer. The Norfolk fine sand occupies higher situations and is well drained. The chief difference between the Norfolk fine sand and the Leon fine sand is the white or very light color and the occurrence of a hardpan layer in the subsoil of the latter.

In extent the Norfolk fine sand is exceeded in Bradford County only by the Portsmouth fine sand and fine sandy loam. It occurs in almost all parts of the county, though its most general development is along the Clay County line southeast of Hampton, in the limestone sink region in the southwest corner of the county, and along the valley of Olustee Creek in the western part.

The topography of the Norfolk fine sand usually varies from almost level to undulating. The more nearly level areas are usually darker at the surface, owing to the accumulation of organic matter. In all cases the drainage is adequate and in the more rolling areas it is even excessive. In the southwestern part of the county the topography is slightly modified and the drainage made more thorough by the occurrence of numerous limestone sinks, through which the drainage water is carried off into subterranean channels.

The Norfolk fine sand supports a growth of pine, blackjack oak, turkey oak, water oak, and live oak. There is a scattered growth of wire grass.

An analysis of a typical sample of this soil to determine its lime requirements gave the following results:

	CaO per acre-foot.	$CaCO_3$ per acre-foot.
	Pounds.	*Pounds.*
Soil	2,450	5,900
Subsoil	1,750	3,500

Probably 80 per cent of the type is under cultivation. The soil is easily handled, and produces well under ordinary conditions. With continuous cultivation the humus content decreases rapidly unless maintained by the addition of green manure or barnyard refuse at frequent intervals. Crop rotation has received but little attention on the type, the farmers in most cases hoping to compensate by heavy applications of commercial fertilizers the damage done by injudicious farm practices. The restoration of this type from an impoverished condition may be more quickly accomplished than in case of most of the soils of the county.

The Norfolk fine sand is naturally a warm soil, while the texture is such as to retain, especially in the flat areas, a water supply sufficient for the maturing of most crops. It is regarded as a very desirable soil for early truck crops and is extensively utilized along the Atlantic seaboard for the growing of such crops as must be forced to an early maturity in order to command the high prices of the winter and early spring markets. Among the products of this class are Irish potatoes, cucumbers, peppers, snap beans, watermelons, cantaloupes, lettuce, radishes, green peas, and most of the berries. In certain localities cigar-wrapper tobacco has been successfully grown on this type under shades and with irrigation.

The type in Bradford County is used mainly for the general farm crops. Cotton and corn are grown extensively and do well with heavy applications of commercial fertilizer. Corn averages about 15 bushels and cotton about one-third bale per acre. Cowpeas and velvet beans do well and are excellent crops to include in rotations. Sugar cane ordinarily produces 8 to 15 barrels of sirup per acre, though the yield varies widely with the season. Sweet potatoes produce about 300 bushels per acre. Oranges and grapefruit do exceptionally well on this type. There are several small commercial groves in the southeastern part of the county, and small groves for home use are numerous. Peaches are also grown in the same locality.

The price of land of this type of soil in sections more remote from markets or shipping points is $10, and in more favorable locations from $20 to $40 an acre.

NORFOLK LOAMY SAND.

The Norfolk loamy sand consists of about 8 inches of brownish-gray or light-brown loamy sand, resting upon a brownish-yellow loamy sand. The color becomes lighter with depth, and at 36 inches the material is usually bright yellow or golden yellow. Both the soil and subsoil are decidedly more coherent than the material of either the Norfolk fine sand or Norfolk sand, and the type is considerably more retentive of moisture. In the southwestern part of the county

some small areas of loamy fine sand are included with this type. The agricultural value of such areas is similar to that of the main type, which fact, with their small extent, made it seem inexpedient to show them as a separate type on the map.

The Norfolk loamy sand occupies nearly level situations, slightly elevated above the adjacent Portsmouth soils, into which it grades almost imperceptibly. In places erosion has given a gently undulating topography. In lower positions near the poorer drained Portsmouth soils the color of the soil grades from the typical to a dark gray or dark grayish brown, and of the subsoil to a yellowish brown. Where the topography is undulating the color of the soil and subsoil varies, the lighter shades of brown prevailing on the slopes and the darker colors in the depressions and flat areas.

Owing to its position and surface configuration the type is thoroughly but not excessively drained, and under ordinary conditions it retains sufficient moisture for the maturing of almost any of the crops commonly grown.

In its natural condition the type supports a growth of longleaf pine, a few scattered water oaks, and a thrifty growth of wire grass.

The type is confined to the south-central and southwestern parts of the county, and comprises a part of the better drained country above the New and Santa Fe Rivers and Olustee Creek.

Most of the Norfolk loamy sand is under cultivation. It is one of the most productive soils in the county, and is used for the production of the general farm crops common to the region. Fertilizers are used extensively and are deemed necessary for the best yields. From 10 to 30 bushels of corn and from one-third to one-half bale of cotton per acre are the ordinary ranges in the yields of these staples. Velvet beans, cowpeas, peanuts, and oats do well. Litmus tests show the soil to be decidedly acid. Applications of either burnt lime or limestone would be beneficial.

Land of this type ranges in value from $15 to $25 an acre, the higher price being asked for improved property of even surface and near markets or shipping points.

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

Mechanical analyses of Norfolk loamy sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
261115	Soil	1.1	14.1	21.9	36.4	12.0	5.5	8.9
261116	Subsoil	.5	12.0	24.9	38.9	10.4	3.8	9.7

NORFOLK FINE SANDY LOAM.

The surface soil of the Norfolk fine sandy loam is a light-gray to light brownish gray fine sand, underlain at about 6 to 10 inches by a yellow or pale-yellow loamy fine sand to fine sandy loam, which becomes heavier with depth, and at an average depth of about 28 inches passes abruptly into a yellow or pale-yellow, friable fine sandy clay. The surface soil is darker in the more nearly level areas, where the organic-matter content is higher, and the lower part of the subsoil in the poorer drained depressions is often slightly mottled with yellowish red and sometimes with gray.

Although this type is not extensive, it occurs in all parts of the county. The largest single area lies southwest of Lake Butler. As a whole this type is well drained, although there are slight depressions in some areas which receive the surface drainage from the adjoining higher land and sometimes remain wet for long periods. The surface features of the Norfolk fine sandy loam resemble very closely those of the more nearly level areas of the Norfolk fine sand. The topography is nearly level to undulating. This type is much more retentive of moisture than the Norfolk fine sand.

The natural vegetation consists mainly of a heavy growth of longleaf pine, with scattered water oak, blackjack oak, and live oak on the more sandy phases. Wire grass grows luxuriantly.

The soil is naturally well supplied with humus, which accounts for the dark color of the immediate surface of forested areas. By continuous cultivation the content of vegetable matter is diminished, and the soil loses its dark color and loamy feel unless additional vegetable matter is supplied. There is a general need over this type for the practice of systematic crop rotation and for the application of large quantities of stable manure or the plowing under of occasional green crops, such as cowpeas, velvet beans, or beggarweed, in order to maintain the supply of humus in the soil.

Most of the type is under cultivation. It is considered one of the strongest soils in the county for general farm crops. Corn and cotton do well without heavy applications of commercial fertilizer. Corn averages about 18 bushels per acre, though some farmers secure much larger yields. Cotton ordinarily produces from one-fifth to one-third bale per acre. Cowpeas and velvet beans do well. Peanuts are frequently planted in the corn rows and fed to stock after the corn has been harvested. Oats and rye are grown for forage and are cut just before the grain ripens. The soil is well adapted to millet, which has lately been introduced. Sweet potatoes and Irish potatoes both produce good yields. Sugar cane, strawberries, pecans, Scuppernong grapes, and bramble fruits also succeed on the type.

Though the Norfolk fine sandy loam is not quite so early in maturing vegetables as the Norfolk fine sand, it is used extensively in other

localities for trucking with good results. Cigar-wrapper tobacco has been grown successfully under shade on this type in other sections of Florida.

The Norfolk fine sandy loam is held at about the same prices as the Norfolk fine sand.

Leon Series.

The Leon series comprises the loose, light-gray to white sandy soils of the south Atlantic and east Gulf coast flatwoods region, which in their typical development have a hardpan stratum usually at a depth of 12 to 24 inches. This stratum ranges from 8 to 10 inches in thickness and consists of a compact layer of fine sand or sand ranging in color from black to dark rusty brown in the upper 2 or 3 inches to rusty brown or slightly darker in the lower portion. The material of this layer runs high in organic matter and low in iron, and although the color would suggest cementation with iron, the analyses indicate that the compactness is due rather to the presence of organic matter. In places the stratum lies sufficiently near the surface to be plowed up, under which condition it is said crops give poor yields. But one type of the series, the fine sand, occurs in Bradford County.

LEON FINE SAND.

The Leon fine sand consists of about 3 inches of gray or dark-gray fine sand, underlain by a white or light-gray, incoherent fine sand, which extends to a depth of 3 feet or more. At depths varying from 8 to 30 inches, though usually at 18 to 24 inches, a black or dark-brown, dense hardpan layer is encountered, which is penetrated with difficulty by the soil auger. This hardpan is similar to that occurring in both the Portsmouth fine sand and Portsmouth sand, but the material is usually more dense. In exceptional cases the hardpan layer does not occur in the 3-foot section, though its absence is less frequent than in the case of the other two types in which a hardpan occurs.

This type differs from the Portsmouth fine sand in the light color of the soil and the general incoherent nature of the surface soil, due to its low organic matter content. It differs from the Norfolk fine sand in the lighter color of the soil and subsoil and the presence of the hardpan layer.

The Leon fine sand occupies a slightly higher position than the Portsmouth fine sand. It occurs on sandy ridges which form the divides of streams in the flatwoods country. Its elevation above the surrounding country is slight and the slope in most cases almost imperceptible. The type supports a characteristic native vegetation of scrubby saw palmetto, longleaf pine, wire grass, gallberry, and a variety of evergreen oak that attains a height usually not exceeding

8 inches. The trees are commonly called "oak runners" on account of their long roots, which spread out just beneath the surface.

The Leon fine sand has its most extensive development to the north and northwest of Lake Butler. Practically none of the type is under cultivation, and it is generally considered an unproductive soil. Owing to the heavy growth of saw palmetto and oak runners, the land is difficult to clear. The loose, open structure of the soil and the small quantity of organic matter present tend to make the drainage excessive, and even under ordinary conditions crops suffer for lack of moisture. With irrigation and liberal applications of commercial fertilizers a great variety of vegetables common to the region can be grown, though only by very intensive methods can success be attained in the cultivation of the type.

Coxville Series.

The Coxville series comprises dark-gray to nearly black soils. The subsoils range from a moderately mellow, friable clay in the upper portion to yellowish, rather plastic, compact clay mottled with drab and light red in the lower portion. The topography is prevailingly flat, with frequent sparsely forested areas. The treeless lands are found in the savannas of the seaward portion of the Atlantic Coastal Plain. The flat surface induces poor drainage. The soils are used for the production of cotton, corn, and oats. In the Carolinas strawberries are grown with profit. When well drained the types are somewhat more productive than the Norfolk soils. The series has been mapped mainly in North Carolina, South Carolina, and Georgia. Only one type in the series is found in Bradford County, and the area of this type is but little more than 3 square miles.

COXVILLE FINE SANDY LOAM.

The surface soil of the Coxville fine sandy loam consists of gray to dark-gray or nearly black fine sand containing a high percentage of organic matter. At an average depth of about 8 inches the material passes abruptly into a very pale yellow fine sand, which in the less thoroughly drained areas is almost white or light gray. At about 18 inches a more distinctly yellow loamy fine sand, which is unevenly mottled with drab and gray, is encountered. With increasing depth the mottlings become more pronounced and the texture heavier, until at about 28 inches a friable fine sandy clay or heavy fine sandy loam, having a complexly mottled yellow, drab, red, and brown color, is encountered. In the lower part of the 3-foot section the subsoil is decidedly heavy and in places is a plastic clay.

The Coxville fine sandy loam in Bradford County is not typically developed. It was only separated from the Portsmouth fine sandy

loam because of its slightly better drainage and its mottled subsoil. The color of the surface soil departs from the typical gray in places, becoming brown or grayish brown. The type also varies considerably in color with depth, though throughout the 3-foot section the soil has a mottled color. The texture of the deep subsoil is variable also, ranging from a heavy fine sandy loam through a fine sandy clay to a stiff clay containing a little fine sand. In the largest area of this type, east of Sapp and west of the point at which New River enters the county, the lighter subsoil predominates, while in the area along the Raiford and Lawtey road the material is heavier at lower depths.

The type occupies slightly elevated areas within the Portsmouth soils. Its drainage and oxidation represent an intermediate condition between the lower lying Portsmouth soils and the more elevated and better drained soils of the Norfolk series. The surface is flat to very slightly undulating. The type includes slight depressions occupied by cypress ponds and "bays."

The Coxville fine sandy loam supports a natural growth of longleaf yellow pine, slash pine, and wire grass. Small, stunted saw palmettos are occasionally seen, though they do not grow as profusely on this type as on some of the other soils. Most of the land has been cut over and the merchantable timber removed. The remaining trees are "boxed" for turpentine. Practically none of the type is under cultivation, though it is a better soil for general farm crops than the Portsmouth fine sand, and the yields should be equal to if not better than those secured on the Portsmouth fine sandy loam. With small expenditure the Coxville fine sandy loam could be drained by means of open ditches. Land of this type is valued at $8 to $10 an acre.

BLACK SOILS.

SEDIMENTARY MATERIAL—SANDS AND CLAYS.

Portsmouth Series.

The Portsmouth series includes dark-gray to black soils, resting on light-gray or mottled gray and yellow subsoils. The soils are high in organic matter, and the heavier members are always plastic, though carrying a noticeable quantity of sand. The soils of this series are developed in flat or slightly depressed, poorly drained areas. The series is most extensively developed in the flatwoods or low seaward portion of the Coastal Plain east of the Mississippi River, though scattered areas are found also in the higher parts of the Coastal Plain country. When drained the different types are used to grow corn and truck crops. In extent, at least, this series is the most important in Bradford County.

PORTSMOUTH SAND.

The Portsmouth sand consists of a dark-gray to black sand, 5 to 10 inches deep, underlain by a dark-gray to gray sand. Somewhere within the 3-foot section a hardpan layer is generally encountered, usually between 18 and 24 inches. This stratum averages about 6 inches in thickness and is dark colored, while the material beneath it is stained a dark brown by leachings from above.

In places the hardpan stratum is not encountered within the 3-foot section. Like that occurring in the Portsmouth fine sand and the Leon fine sand, the hardpan layer is denser in its upper 3 inches, where it has a characteristic dark-brown or black color. Beneath this dense portion the sand particles are less closely cemented together and the material is lighter in color. In places the lower subsoil becomes lighter in color with depth, and at 3 feet is light gray or faintly brownish gray.

The lower depth of the 3-foot section is usually saturated, and the water table in many cases rises to within 18 inches of the surface. The type owes its characteristic dark color to an accumulation of organic matter in the soil under imperfect drainage conditions.

As compared with other members of the series the Portsmouth sand has a small area in the county. In the eastern section, near the Clay County line, the type occurs on the gentle slope from the general level of the flatwoods to the higher country occupied by the Norfolk sand. Between Brooker and Worthington the soil is found typically developed. It has a flat to very gently undulating topography, and is classed as a "flatwoods" soil. "Bays" and cypress ponds of varying size are commonly encountered within it. The native vegetation comprises longleaf pine, slash pine, saw palmetto, gallberry, and wire grass.

Very little of the type is under cultivation. Where well drained, good yields of certain truck crops, especially cabbage and onions, may be expected. This soil does not warm up in the early spring, as do the lighter soils of the Norfolk series, but the larger yields compensate for the later maturity of the crops. Of the general farm crops, the type is best adapted to corn. The soil, however, is too light for general farming. Applications of lime are generally beneficial on all of the Portsmouth soils.

PORTSMOUTH FINE SAND.

The Portsmouth fine sand, in its typical development, consists of a dark-gray to black fine sand, which has a decided loamy feel, owing to its high organic-matter content. The black surface material passes abruptly into a light-gray, incoherent fine sand at depths varying from 5 to 15 inches and averaging about 8 inches. This is

underlain by a dense, compact hardpan layer, usually at a depth of 18 to 24 inches. The hardpan stratum is characteristically dark brown or black in the upper part, but it quickly grades into a copper-brown, rusty-brown, or "coffee-grounds" color, and becomes less compact with depth. This layer is usually from 4 to 8 inches in thickness, and the dark, dense portion comprising the upper part averages 3 inches. Below the hardpan stratum the material to a depth of 36 inches or more varies from a light-brown to a light-gray, incoherent fine sand, usually saturated.

The depth to the hardpan layer is extremely variable. It may occur immediately below the black surface soil or at any depth within the 3-foot section, and in places it is entirely absent. In the latter case the soil grades from the black surface material into a gray fine sand, which continues with uniformity of color and texture to a depth of 3 feet or more. Though all these variations may occur within a comparatively small area, it is quite exceptional to find the hardpan absent over a tract of any considerable extent. The areas having no hardpan in the 3-foot section comprise a phase intermediate between the typical Portsmouth fine sand and the Portsmouth fine sandy loam.

The origin of the hardpan layer in the subsoil is not definitely known, though it is believed to be caused either by filtration or precipitation of organic matter, carried downward as fine particles or in solution by the percolating water, at or near the mean level of the water table. The hardpan stratum has frequently been ascribed to the precipitation of iron salts leached from the surface, and it is a popular belief that it is rich in iron, but laboratory tests show that the content of iron is not very much greater than in other parts of the soil section, while the content of organic matter is high. Water solutions show a brownish color similar to that of the streams of the region, which indicates that a part of the cementing material is soluble.

The Portsmouth fine sand is of greater extent and more widely distributed than any other type, areas of this soil occurring in all parts of the county. It has a nearly level topography, slightly varied by low ridges and gentle slopes toward depressed areas or cypress ponds. The type occupies the larger part of the "flatwoods" section and is locally designated as "sand-soak land," "hardpan land," and "palmetto flatwoods." Saw palmetto is usually abundant, except in the northeastern part of the county. The type supports a thick growth of gallberry and usually of wire grass. The tree growth consists of longleaf pine, shortleaf pine, and slash pine. Most of the longleaf pine is "boxed" for turpentine, and large tracts of "cut-over" land are included in the type. A very small part of the type is under cultivation.

The most important factor limiting crop production on the Portsmouth fine sand is drainage. The greater part of the type is sufficiently elevated above the stream channels to permit drainage by means of open ditches, and much of the type can be cheaply drained by individuals. It is believed that thorough drainage will gradually eliminate the detrimental effects of the hardpan. Laboratory tests show that a part of the hardpan material is soluble, and field observations show a discoloration of the white sand underlying the stratum by leachings. With thorough underdrainage it is believed that this part of the material would be carried away and that the stratum would then disintegrate, or at least become more permeable.

In connection with drainage, the application of lime will be found beneficial. Field tests show the soil to be acid throughout the 3-foot section, and the hardpan stratum to be exceptionally so. Laboratory tests of a typical sample show the following quantities of lime necessary to neutralize the acidity:

Lime requirements of Portsmouth fine sand.

	CaO per acre-foot.	$CaCO_3$ per acre-foot.
	Pounds.	*Pounds.*
Surface soil	3,850	7,700
Hardpan stratum	6,300	12,600
Subsoil	2,450	5,900

Many farmers deem it unwise to bring the material of the brown hardpan layer to the surface in plowing, as it is said crops give poor results where this material is exposed. In some cases dynamite is used to break up the hardpan layer and improve its condition for plant growth.

The supply of organic matter which gives to the Portsmouth fine sand its characteristic dark color and loamy texture is rapidly depleted by cultivation unless frequent additions are made, the soil becoming ashy gray in color. Plowing under crops of cowpeas, velvet beans, or beggarweed is the best means of maintaining the organic-matter content where stable manure is not available.

The strawberry industry has attained its highest development on the Portsmouth fine sand around Starke and Lawtey. The berries grown upon this type usually reach the market a little earlier than those grown on the heavier soils.

Although the type is better adapted to early truck crops, small areas in more remote sections of the county are devoted to staple crops. Corn yields average about 15 bushels per acre, seed cotton produces one-fifth to one-third bale per acre, and oats about 10 bushels. Cabbage and tomatoes do well on the type. Sweet potatoes average about 250 bushels.

The price for which the Portsmouth fine sand is sold varies greatly with its proximity to market. In more remote sections it can be bought for $5 an acre, while that near market or shipping points, and suitable for strawberry culture, but unimproved, is valued at about $10. The most desirable areas, cleared, improved, and close to market, are held at about $80 an acre.

PORTSMOUTH FINE SANDY LOAM.

The soil of the Portsmouth fine sandy loam consists of a black or very dark gray fine sand having a high organic-matter content. At an average depth of 8 to 10 inches this material is underlain by a gray to nearly white fine sand, which continues to a depth generally varying from 18 to 34 inches, where it passes abruptly into a drab, mottled drab and yellow, or mottled gray and yellow fine sandy loam to slightly plastic fine sandy clay. A hardpan layer, similar to that encountered in the Portsmouth fine sand, is sometimes encountered in the sandy layer lying between the surface soil and the heavier subsoil, but the occurrence of hardpan in this type is rather exceptional, and where it does occur it is seldom as thick or dense as that found in the fine sand type. Wherever the fine sandy loam or mottled clay is encountered within the 3-foot soil section, areas otherwise resembling the Portsmouth fine sand were mapped as the fine sandy loam.

Areas of this type are scattered throughout the county, the largest lying around Raiford and extending east to the county line. Another large area lies south of Starke. The type occupies poorly drained, flat, or depressed areas, usually without sufficient slope or drainage outlet for the establishment of good drainage. Irregular-shaped "bays" and "cypress ponds" are common throughout the type. A part of the type occupies long, gentle slopes where the fall is sufficient to make artificial drainage, by means of extensive systems of ditching, practicable.

Unless artificially drained much of the type is too wet for farming, and consequently a large part of it is unimproved. The forest growth consists largely of pine. Most of the marketable timber has been or is being removed, while practically all of the remainder is "boxed" for turpentine. The gallberry and wire grass grow profusely.

When properly drained the Portsmouth fine sandy loam is capable of producing good yields of either the staple crops or such special crops as strawberries, Irish potatoes, lettuce, tomatoes, eggplant, cauliflower, and celery. Between Lawtey and Raiford the type is used extensively for strawberries. The plants are set in beds, which are thrown up a foot or more above the general level of the field in order to protect the roots from excessive moisture. While the berries do well with proper fertilization and cultivation, they are slightly

later than those grown upon the warmer and better drained soils. This is true in the case of practically all crops grown.

This soil is also used successfully in the production of Irish potatoes and tomatoes. Corn averages about 15 bushels and cotton about one-fifth bale per acre. The chief deficiency of the type is lack of drainage, and where ditching is not practical the bed or ridge method of cultivation is necessary. In places the beds are laid off so as to accommodate four to six or more rows of corn or cotton.

This type is a stronger soil than the Portsmouth fine sand, and equally good results are obtained with lighter applications of commercial fertilizers. The Portsmouth fine sandy loam is also easier to improve and is more resistant to drought than the Portsmouth fine sand. The type in its natural condition is slightly acid and, like many other poorly drained black soils, needs lime.

Prices for land of this type range from $8 to $15 an acre, according to location.

Scranton Series.

The Scranton soils are characterized by their dark-gray to black surface soils and friable yellow subsoils. The former have the characteristics of the Portsmouth series; the latter resemble the subsoils of the Norfolk. In the poorer drained areas grayish mottling is frequently noticeable in the deeper subsoil. The surface is flat and the land is generally in need of drainage, such as can be secured in most cases by constructing ditches. The Scranton soils are most extensively and typically developed in the flatwoods country near the coast of the South Atlantic States and in the low flatlands near the Gulf of Mexico, east of the Mississippi River.

SCRANTON FINE SANDY LOAM.

The surface soil of the Scranton fine sandy loam, to an average depth of 6 inches, consists of a black or dark-gray fine sand, which, on account of its high organic-matter content, has a decidedly loamy feel. This material passes abruptly into a pale-yellow or grayish-yellow fine sand, which is uniform in texture and color to a depth averaging about 28 inches, where a yellow or slightly mottled yellow and gray fine sandy loam or friable fine sandy clay is encountered. In places the fine sandy loam or fine sandy clay does not occur within the 3-foot section, in which case the soil would have been mapped as the fine sand of the series but for the patchy occurrence of such bodies.

The type is intermediate between the poorly drained Portsmouth soils and the higher and better drained Norfolk soils. The surface soil is essentially similar to those of the Portsmouth types, while the subsoil resembles very closely that of the poorer drained areas of the Norfolk fine sandy loam.

The Scranton fine sandy loam occupies positions intermediate between the low-lying, flat Portsmouth fine sand and the more ele-

vated Norfolk soils. The surface is flat, and only a few feet higher than the adjoining flatwoods country. The drainage, while decidedly better than that of the Portsmouth soils, is in many cases insufficient for the best results with crops.

After a few years of continuous cultivation the organic-matter content of the surface soil becomes depleted and the material assumes a much lighter color, in which case the type becomes more like the Norfolk. As in the case of most soils of deficient drainage, the Scranton fine sandy loam shows an acid reaction when tested with litmus. Applications of lime, either in the form of burnt lime or ground limestone, are therefore necessary to enable the farmer to secure the maximum yields of most crops.

As in the case of the Portsmouth soils, the most important factor influencing crop production on the Scranton fine sandy loam is drainage. Open ditches have been constructed in places to carry off the excess water. Crops are sometimes grown on beds raised a few feet above the general surface and corn and cotton are grown on high ridges.

The type is inextensive, but is encountered in nearly every part of the county. In its natural condition it supports a growth of pine, gallberry, and wire grass. A large part of the type is under cultivation to the general farm crops. Strawberries and vegetables are also grown. Strawberries do particularly well on this soil. With proper fertilization, oats, corn, sugar cane, forage crops, Irish potatoes, tomatoes, and a large number of vegetables can be grown successfully.

ALLUVIAL MATERIAL—MIXED DERIVATION.

Johnston Series.

Soils of the Johnston series are distinguished by the black color of the surface and the gray, yellow, and brownish color of the subsoils. These soils are alluvial first-bottom soils in the Coastal Plain region. They are subject to overflow. They are derived from materials washed for the most part from Coastal Plain soils, with an admixture of material from Piedmont soils along streams issuing from that province into the Coastal Plain province. No such admixture is found in the soils of the present survey.

JOHNSTON FINE SAND.

The soil of the Johnston fine sand, to a depth varying from 6 to 15 inches and averaging about 8 inches, consists of a black or dark-gray fine sand with a high organic-matter content. The subsoil is a light-gray or gray fine sand. Its texture is decidedly variable, and at different depths in the same section the size of the particles often varies from fine to coarse, though the fine sand usually predominates. In places the heavy clay subsoil of the Johnston fine sandy loam is encountered within the 3-foot section, while at a short distance in any direction the fine sand continues to a depth of 3 feet or more. The

two types grade into each other and are frequently so closely associated as to necessitate mapping according to the predominating type. In places the Johnston fine sand grades into the uplands so imperceptibly that it is difficult to determine the exact boundaries between the overflowed land and the upland, there being a close resemblance between this type and the higher lying Portsmouth fine sand. Where the Johnston fine sand grades into the Portsmouth fine sand, the typical Portsmouth hardpan is frequently present, even though the area is regularly overflowed. On the lower areas, near the stream banks, the black surface layer is sometimes only 2 to 4 inches deep and the soil often has a decidedly loamy feel on account of the greater silt content. These silty areas, however, are too small to be separated on the map from the typical.

This soil occupies the flood plains of the smaller streams of the county. Most of the type is elevated only a foot or two above the general level of the streams, and during seasons of heavy rainfall it is entirely inundated. The material consists of alluvial deposits derived from the upland soils of the drainage basins of the streams along which the type occurs. The topography is level, with only an imperceptible slope toward the stream channels. There are a few very slight ridges and swales. In the southwestern part of the county there are two narrow strips of soil similar to this type, which, although apparently of alluvial origin, stand above overflow somewhat like second-bottom soils. The relatively high position occupied by these areas has resulted from the formation of limestone sinks nearer the stream.

The Johnston fine sand supports a characteristic natural growth of shortleaf and longleaf pine, slash pine, magnolia pine, palmetto, scrub varieties of holly and oak, titi, gallberry, bay, ironwood, haw, water or turkey oak, sweet gum, ash, magnolia, hickory, myrtle, and pecan.

Practically none of the type is cleared for agricultural use. The merchantable timber has in most cases been removed, and the remaining longleaf pine is "boxed" for turpentine. The type is used largely for pasture. Water stands over much of this soil during a large part of the year, and artificial drainage is necessary before it can be utilized for farming.

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

Mechanical analyses of Johnston fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*
261136	Soil	0.2	0.7	1.5	45.9	37.7	6.7	7.7
261137	Subsoil	.0	.6	1.8	54.1	35.0	5.3	3.3

JOHNSTON FINE SANDY LOAM.

The soil of the Johnston fine sandy loam, to an average depth of about 15 inches, consists of a black or very dark gray fine sand or loamy fine sand, containing a large amount of organic matter. Beneath this the material is a light-gray or gray fine sand, which, at about 24 inches, grades into a drab and yellow mottled, plastic fine sandy clay or clay. In places the black surface layer is not more than 3 or 4 inches deep. The light-gray subsurface soil, or the material between the black surface and the stiff clay subsoil, is sometimes mottled with yellow or brown, and occasional strata of orange-colored sand are encountered between these depths.

The Johnston fine sandy loam is the predominating bottom soil of the county, and is developed along the larger streams. The bottoms along the Santa Fe and New Rivers are prevailingly of this type, though in places in such areas the clay does not occur within the 3-foot section.

The type occupies the low first bottoms along the streams and is subject to frequent overflow. Adjoining the stream there are some low, poorly drained areas where the surface seldom dries between overflows. These areas constitute a swampy phase of the type, which supports a natural growth consisting mainly of water or turkey oak, ironwood, haw, sweet gum, ash, and slash pine. Owing to the accumulation and decomposition of vegetable matter under conditions of poor drainage, the surface soil has a somewhat mucky nature, which is not possessed by the better drained part of the type.

The Johnston fine sandy loam is composed of alluvial stream deposits, consisting wholly of reworked Coastal Plain material.

Practically none of the type is under cultivation. In most cases the merchantable timber has been removed and the remaining longleaf pine is "boxed" for turpentine. The type is devoted largely to pasture and the production of naval stores. It can not be profitably utilized for agriculture until reclaimed by means of extensive drainage systems.

The results of mechanical analyses of samples of the soil and subsoil of this type are given in the following table:

Mechanical analyses of Johnston fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
261124	Soil	0.5	5.2	10.4	52.6	21.1	6.4	4.1
261125	Subsoil	.7	6.1	9.4	48.8	18.5	5.7	10.8

Miscellaneous Material.

PEAT.

The soil mapped as Peat consists of brown, partially decomposed vegetable matter having a depth of 3 feet or more. The material to a depth of 3 or 4 inches is usually black or nearly black in color and has a fine texture, the vegetable matter having largely decomposed beyond the fibrous stage, though some of the plant remains show the original structure. The material is free from grit or mineral matter.

The topography of the Peat is level, and the surface, with the exception of frequent tussocks of vegetation that have grown up around roots, stumps, and cypress knees, is inundated during the greater part of the year. The material is sufficiently fibrous to absorb and retain large quantities of water. A larger part of the type, however, could be effectively drained. The Peat is deeper in some places than in others, and when it is drained uneven shrinkage might cause slight irregularities in the surface configuration. The type occurs in the larger cypress ponds, "bays," and in low areas around the edge of lakes.

While it is probable that the Peat is derived largely from the accumulation and subsequent decomposition of sphagnum moss in areas of poor drainage, the remains of other water-loving plants and trees are also included with the material. The deposits have accumulated within ponds or lakes or along the courses of sluggish streams.

Much of the type supports a dense growth of cypress, bay, smilax or "bamboo vine," pine, and a variety of swamp huckleberry. There is also a growth of sphagnum moss and ferns.

While Peat when well drained is well adapted to the production of special crops—such as celery, onions, cabbage, tomatoes, and Irish potatoes—it is less desirable for the general farm crops than Muck. A part of the Peat bed around Sampson Lake was at one time partially drained and used for several years for growing rice, but the crop suffered from "blight," so that rice production became unprofitable, and the cultivated area was allowed to return to its submerged condition.

MUCK.

The material mapped as Muck consists of partially decomposed vegetable matter mixed with a small amount of mineral matter, mainly fine sand. Decomposition has advanced to that stage where the original structure of the plant material has largely been obliterated. The surface soil is usually underlain at about 15 inches by a dark-gray fine sand. At about 24 inches the gray fine sand generally passes into a dark fine sandy loam to fine sandy clay.

This type occupies "bays" or "cypress ponds" scattered throughout the large areas of Portsmouth fine sand, Portsmouth fine sandy

loam, and Coxville fine sandy loam. Portions of the larger swamps and all of the large swamps north of Santa Fe Lake are chiefly Muck. The surface is under water during the greater part of the year. Cypress, bay, and gum are the principal trees, while ferns and sphagnum moss grow close to the banks and where the water is not too deep. Frequently titi and myrtle fringe the depressions.

The Muck can not be utilized for agricultural purposes without artificial drainage. The reclamation of the type can generally be effected by open ditches. When thoroughly drained Muck is one of the best soils in the county for the production of vegetables, especially celery, cabbage, tomatoes, Irish potatoes, and onions, which require a soil having a large humus content. It is also well adapted to sugar cane. After the type is thoroughly drained, the application of lime in sufficient quantities to correct acidity is beneficial. General farm crops—such as corn, cotton, and oats—do exceptionally well on drained Muck areas after sufficient applications of lime have been made.

There are many small areas of Muck, varying in size from 1 to 4 or 5 acres, occupying small depressions within the various types throughout the county. These are not shown on the map, owing to their small size.

SUMMARY.

Bradford County is situated in the northeastern part of Florida, and has an area of 539 square miles, or 344,960 acres. Starke is the county seat and largest town. The topography varies from flat to hilly, and much of the county is poorly drained. There is a range in elevation from 135 to 175 feet above sea level.

The climate is mild, the mean temperature for the coldest months, December, January, and February, being about 56° F., and the mean summer temperature 81° F. There is a mean annual precipitation of about 51 inches.

There are about 110 miles of railroad in the county. Two main lines of railroad connect the county with Jacksonville and a third with northern points. Two branch roads extend into the southern part of the county.

Only a small part of the county is under cultivation, although agriculture seems to be entering a period of development. The lumber and turpentine industries are important. Where the forest growth has been removed the lands are being cultivated, and there is a general tendency toward more intensive farming, such as the growing of strawberries or truck crops in place of cotton or corn.

The farm crops consist of corn, cotton, strawberries, cowpeas, velvet beans, peanuts, oats, rye, millet, sugar cane, sweet potatoes, Irish potatoes, and rice. Of these corn occupies the largest total area, but strawberries bring the largest returns. Long-staple cotton is grown

exclusively. Cowpeas, velvet beans, peanuts, oats, rye, and millet are grown mainly for forage. Sugar cane, sweet potatoes, Irish potatoes, and rice are minor crops grown largely for home consumption, though with several of these there is a possibility of commercial development. Oranges, grapefruit, and pecans are grown on a small scale for local markets. The greatest agricultural possibility of the county is along the line of truck farming.

The soils consist of sands, fine sands, and fine sandy loams and owe their origin to unconsolidated deposits of the Coastal Plain. The types are comparatively few and belong to the Norfolk, Portsmouth, Scranton, Leon, Coxville, and Johnston series, with the two miscellaneous types, Peat and Muck.

The Norfolk series includes the light-colored upland soils, which occupy the higher areas and are comparatively well drained. The fine sand and sand are good early truck soils. The fine sandy loam is one of the best soils in the county for general farming. The loamy sand is also well adapted to the general farm crops.

The Portsmouth soils all need drainage to fit them for agriculture. The fine sand comprises the largest area and is the main type in the flatwoods country. The strawberry industry has been developed on this soil around Starke and Lawtey. It is a good truck soil. The fine sandy loam type is less well drained but is inherently more productive. Strawberries constitute the main crop, though corn and cotton are grown successfully on well-drained areas. The sand type is inextensive. It has about the same crop value as fine sand.

The Scranton fine sandy loam is a good soil for truck crops, but is usually deficient in drainage. The Leon series is represented by only one type, the fine sand. It is devoted almost exclusively to lumbering and turpentining. The Coxville fine sandy loam is also in need of drainage. When reclaimed it is well adapted to truck crops.

The alluvial soils are represented by two types of the Johnston series, the fine sand and fine sandy loam. These soils are subject to frequent overflow and are not under cultivation.

Peat and Muck are unfit for agriculture until drained.

The greatest general requirement of the soils in the county is drainage. After drainage, the application of lime to correct the acid condition of the soils is necessary.

The development of intensive truck farming in the county offers attractive opportunities, as the climate and soils are admirably suited to this type of farming, and much of the land well adapted to trucking close to shipping points may be had at reasonable prices.

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[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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