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Soil Survey
of
McIntosh County, Georgia

By

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and

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United States Department of Agriculture

Bureau of Chemistry and Soils

In cooperation with the
Georgia State College of Agriculture

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SOIL SURVEY OF McINTOSH COUNTY, GEORGIA

By G. L. FULLER, Georgia State College of Agriculture, in Charge, and B. H. HENDRICKSON and J. W. MOON, United States Department of Agriculture

COUNTY SURVEYED

McIntosh County is in the southeastern part of Georgia, about midway in the coastal part of the State, bordering the Atlantic Ocean. (Fig. 1.) Darien, the county seat, is 63 miles south of Savannah, 18 miles north of Brunswick, and 95 miles north of Jacksonville, Fla. The county comprises a land area of 433 square miles or 277,120 acres.

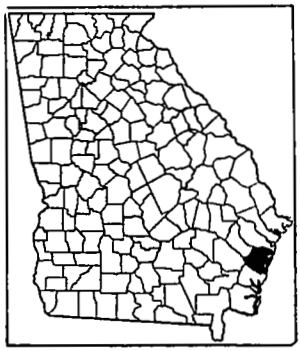

FIGURE 1.—Sketch map showing location of McIntosh County, Ga.

McIntosh County lies entirely within the flatwoods, or seaward, part of the coastal plain and is characterized by low flat surface relief. The mainland is separated from the ocean on the east by a wide margin of tidal salt-water marshland which terminates at a series of barrier islands, about 20 feet in elevation, bordering the ocean. On the southern side of the county, the tidal marsh gradually merges into the delta material of Altamaha River which forms the southern boundary line of the county, and elsewhere it merges into fresh-water swamps extending into the upland. The mainland part of the county includes two physiographic divisions, a higher sand area in the eastern part and a lower flat area in the western part. Parallel to the coast and, to a small extent, parallel to the river swamp is a comparatively high sand area, ranging from 3 to more than 5 miles in width, which continues throughout the length of the county except where cut by swamps or necks of marsh. Elevations on this area range from 20 to 40 feet above sea level. Here the surface relief is broadly rolling, marked by no areas of sharp relief except here and there along the coast a stream-cut bluff which rises to a height ranging from 10 to 30 feet above the water. A high sand-ridge area also borders the Altamaha River swamp in the southwestern part of the county where, in a few places, elevations of 80 feet above sea level are attained, although the greater part of this sand ridge ranges from 30 to 50 feet in height. This sand ridge is more rolling than the coast sand area.

Back of these sand areas, to the north and west, is an extensive low-lying plain which comprises the remainder of the county, covering about one-half of the total area. The surface relief of this plain ranges from flat to slightly undulating with short gentle slopes

bordering many of the swamps. Elevations range from 10 to 20 feet, with a few areas as high as 30 feet above sea level. The elevation at Cox on the Seaboard Air Line Railway is 17 feet, and Townsend and Jones are about 20 feet above sea level.

Considered as to drainage, the county is very young and immature to such an extent that no natural drainage channels are established through the upland soils, owing to the very slight relief throughout the upland area. Many swamps and poorly drained meandering depressions occur, most of which are more or less connected, and in which excess surface water collects and moves seaward, but no established stream channels run through them except a few swamp outlets at the coast. In times of very high floods, water from Altamaha River leaves the river swamp, breaks through the sand ridge in the southwestern corner of the county, and submerges much of the western part, with the exception of scattered higher knolls. At such times Cox, Townsend, Warsaw, and Jones are isolated, except by boat, and persons living on outlying farms are marooned or driven from their homes. Heavy floods have occurred four times within the five years previous to 1929. The flood waters overflowing from the Altamaha River swamp move across the western half of the county to reach the ocean by way of Youngs Swamp into Sapelo River, and by Big Mortar Swamp and Bull Town Swamp into South Newport River. The fundamental problem for utilization of the western part of the county for agriculture is the control of the flood waters of Altamaha River, which must be prevented from inundating the upland areas before any practical and permanent agricultural development can take place. A Federal survey is now being made to determine the feasibility of constructing dikes to confine the river within the swamp. Also, throughout the western part of the county, drainage canals and ditches would be necessary through the swamp areas to remove local excess water.

Throughout the eastern part of the county, on the higher sand-ridge area, numerous long narrow depressions occur parallel to the coast. Most of these merge into incipient drainage ways after heavy rains, but they have no established channels except at the outlet. Drainage is facilitated to some extent by old rice canals, which were built to convey fresh water from mainland swamps to diked rice fields on the marshland, but most of the canals have become filled with sediment. A small amount of artificial drainage has been constructed, principally along the coast, to combat the breeding of mosquitoes, and a few areas have been drained for farming. Extensive drainage operations have been undertaken on Sapelo Island to facilitate the utilization of the lower-lying soils. On the islands in the Altamaha River delta, dikes are necessary to bar both tide and river flood waters before the land can be used. The normal tide for the coast area ranges from 6 to 8 feet, and flood tide can be observed on Altamaha River as far as the Seaboard Air Line Railway bridge when the river is at normal level. However, salt water rarely extends beyond the highway at Darien and, in times of flood, the water is fresh nearly to the ocean. Excessively free drainage inhibits the use for agriculture of many of the sand soils, especially those which are high and remote from the coast.

McIntosh County was originally part of the Spanish district of Guale governed from San Augustin in the colony of Florida. In 1568, Jesuit missions, which later became Franciscan missions, were established along the coast, two being located in this county—San Jose Mission on Sapelo Island and Typiqui Mission at the Indian village of Tolomato on the mainland. Ruins of both missions are still standing, one on the west side of Sapelo Island and the other on the coast about 5 miles north of Darien. An Indian uprising in 1597, starting at Tolomato, resulted in massacre of the missionaries, but the missions were restored with the protection of small garrisons. Conflict with the English gradually forced the Spaniards back until the missions were abandoned in 1686, but Spanish claims were not relinquished until after the battle of Bloody Marsh in 1742. In 1734, a treaty with the Indians was made by Oglethorpe, at Darien, and in 1735 that place was settled by Scots under his direction and was known as New Inverness. Sapelo Island was settled in 1788 by five French monarchist noblemen. Generals Cut (shown on the map) was made across Generals Island at the direction of Oglethorpe, in order to afford readier access from the settlement of Frederica on St. Simons Island to New Inverness, and the Atlantic Coastal Highway is said to closely follow the original route surveyed by Oglethorpe, about 1736, to connect New Inverness with Savannah. During the Revolutionary War and the War of 1812 little development took place in the county, owing to frequent destructive sea raids, but a period of intensive development, which lasted until the Civil War, followed the War of 1812.

Following the Revolutionary War, the lumber resources of the county began to be exploited, and much lumber was cut for the construction of vessels for the Navy. Logs were cut along the coast and on the coastal islands and later were rafted down Altamaha River. Sawmills were built at Darien and on islands closer to the sounds, where ships were loaded with lumber for all ports of Europe. This vicinity was one of the principal lumber markets of the country for a century, and in 1836 the Bank of Darien was said to be the largest bank between Baltimore and New Orleans. An interesting reminder of this old-world trade is the large number of rocks of all kinds, which were brought as ballast from European ports and left on the islands where the vessels were loaded with lumber. These are the only rocks in the county.

McIntosh County was formed from Liberty County in 1793, but in 1871 part of it was returned to Liberty County. The population was reported to be 5,630 in 1845, of which 4,369 were colored. From 1880 to 1910, the population was more than 6,000, but the census of 1930[1] reported only 5,763 inhabitants, all of whom are classed as rural. There are 1,840 native whites, 40 foreign-born whites, and 3,876 negroes in the county, besides a few Japanese from California. The population is densest along the coast, on Sapelo Island, and in small settlements along the railroad in the western part of the county, and a sparse rural population is widely scattered over the rest of the county. Many of the white inhabitants are descend-

[1] Soil survey reports are dated as of the year in which the field work was completed. Later census figures are given whenever possible.

ants of the original settlers, and nearly all the negroes are locally known as "Geechee" negroes whose ancestors were brought to work in the rice fields.

Darien is the county seat and only incorporated town in the county, with a population of 937 reported in 1930, a decrease from 1,739 reported in 1900. Cox, Townsend, Warsaw, and Jones are trading and shipping points in the western part, South Newport in the northern part, and Eulonia in the central part of the county. Post offices are maintained at Darien, Ridgeville, Meridian, Valona, Crescent, Townsend, Jones, and Sapelo. Rural free delivery routes run from Townsend, Jones, and Sapelo to reach most settlements, and Darien and other post offices not on the railroad are served by a star route running between Brunswick and Townsend.

The county is served by the Seabord Air Line Railway which crosses the western part. The Atlantic Coastal Highway, a paved road, which is part of United States Highway No. 17, extending from Savannah to Jacksonville, Fla., passes through the county and is the principal transportation route for regularly operating bus and motor-express lines. A State highway with a sand-clay surface extends west from Eulonia through Townsend to cities in the northern part of the State. Although public roads are few, they reach practically all the settled sections of the county. Most of them are sand-surfaced roads, well graded and usually kept in fair condition, although nearly all the roads west of the Atlantic Coastal Highway are rendered impassable at times by flood waters from Altamaha River. There are three good harbors, entirely or partly within the county, where many ocean-going ships formerly entered for lumber and rice. No large ships now serve the county, but water transportation is provided from both Brunswick and Savannah.

The southeastern part of the county is furnished with light and power by an electric-power line, and nearly all parts are reached by telephones. The county has a good system of consolidated schools with modern buildings, and churches are in nearly all communities. Formerly, considerable difficulty was experienced in procuring satisfactory drinking water, but at present this is obtained from artesian wells in all parts of the county, including the islands.

The largest industry in the county is the production of naval stores, of which approximately 7,000 barrels of turpentine of 50 gallons each and 35,000 barrels of rosin of 280 pounds each are sold annually at a value ranging from $400,000 to $450,000. These products are marketed through Brunswick and Savannah, and about one-fourth of the turpentine and one-half of the rosin are exported. Longleaf and slash pines are the principal trees worked for the crude gum, although a few loblolly pines have been worked but are usually very poor producers. The slash pine is preferred and is reported to produce more gum than the longleaf, which is in sharp contrast to past operations when none but longleaf pines were worked. Production is based on "crops" of trees, 10,000 trees constituting a crop. Production per crop and the quality of the product differ with the size of the trees and the length of time they have been worked, the height of production being about 40 barrels of turpentine per crop. The highest quality turpentine is obtained

from freshly cupped or virgin trees. The stand of trees ranges from 1 or 2 to 50 or more an acre, so that in the better areas 250 acres will constitute a crop and elsewhere from 400 to 500 acres are required for a crop. There is a noticeable difference in the manner in which trees are worked. The better and more conservative method, followed by many producers, consists of putting only 1 cup on smaller trees and working no trees less than 9 inches in diameter. However, it is common, more often on leased land, that trees 5 inches in diameter will have 2 cups and 18 or 20 inch trees 4 or 5 cups, the worked faces completely girdling the tree. It is reported that at least 75 per cent of the mainland area of the county is in the control of turpentine and lumber companies, whose holdings range from a few thousand to more than 50,000 acres. Part of the area is conservatively worked and reforestation is being urged, but elsewhere the methods employed are destructive to the trees, and practically no second growth has developed on account of fires and livestock grazing.

Most of the trees large enough for lumber have been cut, except on scattered small tracts. One sawmill, which is sawing about 60,000 feet of pine a day, is still operating at Warsaw. The company owning this mill has cut both pines and swamp hardwoods but has shipped most of the hardwoods as logs.

Another product of the county is deer's-tongue, or vanilla leaf (*Trilisa odoratissima*), of which about 240,000 pounds a year are picked. The present price is about 7½ cents a pound, at which price the crop is worth about $18,000. The deer's-tongue is shipped mainly to New York, Baltimore, Wilmington, and Richmond, from whence three-fourths to seven-eighths of the crop is exported to Germany and France. Deer's-tongue grows principally on the Leon soils, but it is found in nearly all parts of the county.

A large and varied industry of the county is the gathering, preparation, and sale of sea food. Approximately 40,000 cases of shrimp, worth about $200,000, and 15,000 cases of oysters, worth about $75,000, are canned and shipped annually; in addition, about 2,000 barrels of fresh, or "green," shrimp, worth about $75,000, are also shipped. Most of the canned shrimp is shipped to the New England States, and the oysters are utilized mostly in the Southeastern States. In addition to the income from these products about $18,000 a year is realized from approximately 750 barrels of catfish, shipped to Kansas City and St. Louis, and about 75 barrels of other fish, shipped to various markets.

In addition to the products mentioned, furs worth from $150,000 to $175,000 a year are shipped during the winter. About 90 per cent of this income is from mink and raccoon skins, although many opossums and a few otters are caught.

CLIMATE

The climate of McIntosh County is oceanic and is characterized by long hot summers and short mild winters. Marked extremes of temperature in the vicinity of the coast are tempered by the influence of the ocean.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Valona, McIntosh County, Ga.*

[Elevation, 10 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1907)	Total amount for the wettest year (1902)
	° F	° F	° F	Inches	Inches	Inches
December	51 2	82	15	2 84	3 70	3 20
January	51 6	84	16	2 65	47	54
February	51 8	82	5	3 36	47	3 40
Winter	51 5	84	5	8 85	4 64	7 14
March	61 3	96	22	3 31	1 87	8. 57
April	65 6	93	36	2 65	5 68	2 30
May	73 7	100	44	3 61	5 83	1 10
Spring	66 9	100	22	9 57	13 38	11 97
June	79 1	103	50	4 86	5 33	5 50
July	81 2	104	61	6 72	3 84	6 52
August	80. 8	105	61	7 54	6 50	4 50
Summer	80 4	105	50	19 12	15 67	16 52
September	77 5	100	47	5 64	4 01	8 47
October	67 5	94	35	4. 28	21	14 27
November	59 8	86	18	2 09	1 81	3 91
Fall	68 3	100	18	12 01	6 03	26 65
Year	66 8	105	5	49 55	39 72	62 28

TABLE 2.—*Normal monthly, seasonal, and annual temperature and precipitation at Brunswick, Glynn County, Ga.*

[Elevation, 14 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1916)	Total amount for the wettest year (1920)
	° F	° F	° F	Inches	Inches	Inches
December	55 0	83	19	3 11	4 00	4 74
January	53 5	83	17	2 96	92	1 43
February	54 8	86	13	3 05	1 21	3. 53
Winter	54. 4	86	13	9 12	6. 13	9. 70
March	61 3	99	27	2 92	58	3 62
April	67 6	94	35	3 14	1 33	8 72
May	74. 3	97	44	3 77	2 08	4 60
Spring	67 7	99	27	9 83	3 99	16 94
June	81 1	103	60	5 60	3 63	2 23
July	81 6	101	63	6 81	3 61	8 18
August	81 6	103	65	5 95	7 00	12 99
Summer	81 4	103	60	18 36	14 24	23 40
September	78 2	99	51	6 08	3 00	10 47
October	70 2	95	38	3 73	4. 75	78
November	60. 5	88	26	1 99	1 20	3. 58
Fall	69 6	99	26	11 80	8 95	14 83
Year	68 3	103	13	49 11	33 31	64 87

The average length of the frost-free season is about 260 days, from early March to late November, although in most years the winter is not sufficiently cold to injure winter cover crops, and garden crops are commonly started the latter part of February. A few oranges, grapefruit, and bananas were observed during the survey, but this county lies at the northern limit of their growth and beyond the limits of commercial growth, owing to the frequency of injurious frosts and freezes. Three crops of commercial vegetables can be grown on the same ground during the year, and many subtropical fruits are grown for home use.

Precipitation in the county is comparatively heavy, the mean annual rainfall being more than 49 inches. The rainfall is heaviest during June, July, August, and September, but it is well distributed throughout the rest of the year. Snow seldom falls.

Tables 1 and 2 give the more important climatic data as recorded at Valona, in the east-central part of the county, and at Brunswick, which is in Glynn County, just south of McIntosh County.

AGRICULTURE

The earliest agriculture carried on in the county was probably on Sapelo Island where the Spanish priests and their Indian helpers at the Franciscan mission cultivated large fields, growing sustenance crops and many fruits, including oranges, figs, and pomegranates, before 1608. The early English and Scotch planters, in order to make their settlements self-sustaining, grew a wide variety of crops, including barley, corn, oats, rye, wheat, lucern (alfalfa), turnips, pumpkins, watermelons, potatoes, flax, and hemp.

As has been stated little agricultural development took place between the time of the Revolutionary War and the end of the War of 1812. After the War of 1812, a period of intensive agricultural development began, lasting until the Civil War. During this time probably the most intensive agriculture practiced in the United States was carried on in this section of Georgia. Large estates, which produced sugarcane and sea-island cotton, were developed on the islands and along the coast, and nearly all the delta islands in Altamaha River were diked for rice growing. In 1859, 5,800 acres of rice, yielding 195,000 bushels, were reported in the county. This acreage included 1,000 acres on Butler Island, 1,000 acres on Cambers Island, 500 acres on Broughton Island, 600 acres on Champney Island, 300 acres on Generals Island, and other large rice fields which were on Cathead Creek and along the coast where fresh water could be carried to the rice fields from farther inland. The waters at flood tides were used to irrigate the rice fields on Altamaha River, and tide-power mills were used to some extent to mill the rice, run the cotton gins, and grind the sugarcane. In 1880, the Federal census reported 4,035 acres devoted to rice in 1879, but the acreage has steadily decreased until the last census, when no rice was reported for McIntosh County. None of the old rice fields which were diked and ditched are now used for rice production, but rice is now grown in very small areas in depressions and intermittently wet areas on Sapelo Island and in the western part of the county, for local use. It is reported that the financial returns from rice at the present time are not sufficient to pay the cost of upkeep of the dikes and ditches on the old rice fields.

Table 3 gives the acreages of the more important crops reported by the Federal census during the last five decades.

TABLE 3.—*Acreage of principal crops in McIntosh County, Ga., in stated years*

Crop	1879	1889	1899	1909	1919	1929
Rice	4,035	1,923	1,065	584	269	-------
Corn	2,825	1,240	1,555	1,088	2,864	1,481
Sweetpotatoes	514	436	547	418	335	214
Cotton	339	49	10	16	752	4
Oats	354	39	77	70	54	15
Sugarcane	13	74	159	50	117	46
Potatoes	-------	20	12	7	162	2
Hay	-------	118	48	64	60	88
Dry peas	-------	-------	191	232	31	-------
Peanuts	-------	25	108	26	64	-------

Corn has always occupied an important acreage. Oats, most of which are cut and fed unthreshed, velvetbeans, cowpeas, and a few other crops are grown for hay.

The growing of sea-island cotton became commercially important early in the nineteenth century, but changing conditions have practically eliminated that type of cotton and none is now grown in the county. Although 339 acres were reported in cotton in 1879, by 1889 and thereafter very little was grown until 1919 when 752 acres were reported, which yielded 362 bales. In 1929, however, only 4 acres were reported, and at present no cotton gin is in operation in the county.

Practically all other crops grown were for home consumption. Tobacco was planted very extensively by a development company operating about 1920, but little success was reported, owing largely to the selection of soils unsuited to the crop, and partly to unfamiliarity of the company with local conditions. There were 6,006 pecan trees reported in 1924, but a large number of these trees have been planted on Leon soils which are not the natural habitat for hardwood trees, with the result that growth is poor, the color of the leaves is usually pale green, and, it is reported, the trees do not yield well. Pecan trees planted on suitable soils, such as the Eulonia, Fairhope, Bladen, and Norfolk, produce excellent yields.

At present (1929) a development is under way to produce truck crops for market, and experimental work is being conducted to determine the possibility of producing commercial ornamental shrubs and fruits on the delta land of Altamaha River.

Although the coast section and a few inland areas were at one time highly developed, at present the county is mainly nonagricultural. The percentage of the county classed as farm land by the census has never been large. During the decade between 1910 and 1920, an extensive land-colonization project was started in the county. Farms were cleared in all sections on all kinds of soil, one or more large silos were built on practically every farm unit, and several tobacco barns were built on many by the land company, but the scheme failed, owing principally to the selection of poor soils, and to inexperience in growing crops under local conditions.

In 1930, there were 268 farms in the county, comprising 11.7 per cent of the land area. In the same year 4,731 acres were classed as

crop land, 23,111 acres as pasture land (plowable or woodland), 18,893 acres as woodland not used for pasture, and 10,648 acres as all other land in farms. Most of the land in the county is held in large tracts, ranging in size from 1,000 to more than 50,000 acres, by naval stores companies, lumber companies, and individuals, but the part of the county in strictly farm land is mostly cut into small tracts. About 75 per cent of the farms in the county contained less than 50 acres each in 1930, and 87 per cent contained less than 100 acres each.

Owners operate 90.3 per cent of the farms; tenants, 9 per cent; and managers, 0.7 per cent. Of the 24 tenants reported in 1930, only 7 rented for cash; 5 were croppers, under which system the owner furnishes the tools and work animals and receives a share of the crop; and most of the remaining 12 furnished their own work animals and tools and shared the crop with the owner.

Very little labor is hired on the farms. On most farms, farming operations are supplementary to other operations of the farmer who may work also at fishing, gathering oysters, working trees for turpentine, lumbering, or some other occupation. The supply of labor seems to be sufficient for all local needs, but there is no surplus.

Very little fertilizer is used by the farmers of the county. The fertilizers used include lime, superphosphate, nitrate of soda, and ready-mixed fertilizers. A number of farmers, especially on truck farms, make use of manure and compost. The marked increase in the amount of fertilizer used at present on truck farms accompanies the development of the trucking industry. Applications of 1,000 pounds or more an acre are now common for truck crops. The results obtained by a fertilizer plot demonstration by the State College of Agriculture on corn on Eulonia fine sandy loam, in the western part of the county, and the results of the fertilizer tests being conducted by the Georgia Coastal Plain Horticultural Experiment Station on truck crops on Butler Island, in the southeastern part of the county, should have a marked influence on the kinds and amounts of fertilizer used in the county hereafter.

Farming operations are commonly conducted with a minimum of farm machinery, work animals, and buildings, except on some of the better-managed farms. A few farmers own equipment which is the best that can be provided, including tractors and other modern farm machinery, together with a good grade of work animals, both horses and mules. On many of the smaller farms, especially those on the deeper sand soils, 1-horse plows and similar equipment are common. There is a larger proportion of horses in this county than is common in the State, 203 horses and 43 mules being reported on April 1, 1930.

The census of 1930 reported 5,646 head of cattle in the county. The county has free range on which cattle graze throughout the year, consequently little feed is grown for beef cattle, with the exception of corn which is fed by some farmers just before the cattle are sold. Practically all the range cattle are scrubs or grades. On Sapelo Island, however, there is a herd of purebred Angus beef cattle, which have been successfully fed and marketed. Carpet grass for pasture for these beef cattle was successfully started on large

areas of the Portsmouth and a few of the other soils, and excellent crops of sweetclover have been obtained on the Palm Beach soils. The sweetclover also provides excellent grazing.

The 1930 census reports 3,121 swine on the farms, and most of them are kept for the home supply of meat. A small percentage of all livestock is marketed locally and in Savannah and Brunswick. Poultry is raised almost entirely for home use. There were 4,581 chickens on the farms on April 1, 1930, and 14,782 dozen eggs were sold in 1929

Although the free range provides year-round pasture for all kinds of livestock, it seriously hinders improvement of the herds, owing to the freedom with which all grades are crossed, but some improvement of range cattle has been attempted by stocking the range with good grade or purebred bulls.

Owing to the very small proportion of tilled land in the county some good agricultural soils are not farmed at all, and no soil is farmed very extensively. However, there appears to be increasing interest in agricultural possibilities with a view toward the utilization of the better soils. Little information is available, either in McIntosh County or elsewhere in the State, concerning the fertilizer requirements or the most efficient methods of soil management for the soils in this county. Very little fertilizer is purchased for general farm crops, most of the fertilizer being applied to truck and special crops in a more or less experimental manner. Much experimental work has been started recently, which should furnish much valuable information as a guide for agricultural development.

A fertilizer plot demonstration was started by the Georgia State College of Agriculture in the spring of 1929 on corn planted on Eulonia fine sandy loam in the southwestern part of the county. By the middle of June the beneficial results of superphosphate, with the addition of almost any nitrogen fertilizer, were very marked when compared with unfertilized plots. The experiment station on Butler Island is also conducting fertilizer tests to determine the kind and amount of fertilizer necessary to produce best results on Altamaha clay, with prospects that the same work may be continued on some of the neighboring upland soils. Although results are as yet very incomplete, it has been shown that superphosphate is the major fertilizer requirement on Altamaha clay. A more or less experimental truck farm on Champney Island uses 4–12–4 [2] fertilizer at the rate of 1,000 pounds an acre on cucumbers, peppers, carrots, beets, and eggplants, and 4–8–4 fertilizer is used at the rate of 1,000 pounds an acre on cabbage, 1,200 pounds an acre on turnips, and 500 pounds an acre on radishes. This farm uses from 4 to 5 tons of very fine ground limestone an acre. The Butler Island experiment station is conducting experiments to determine the best kind and amount of lime to use.

A few farmers grow green-manure crops, but such crops are not common, except on the truck farms. One truck farmer grows cowpeas every summer for plowing under, and the Butler Island station is experimenting with various other crops for green manure. Where used, green-manure crops have proved highly beneficial, especially for pecan and fruit trees.

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[2] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

Tillage operations are comparatively easy, except on the clay soils, Altamaha clay and Bladen clay loam. It has been demonstrated on Altamaha clay that it is extremely important to plow and till that soil only when moisture conditions are proper. If tilled too wet, clods are formed which are not easily pulverized but have to weather down, whereas an excellent seed bed can be obtained by tilling under proper moisture conditions. Heavy tractor outfits are used for the initial plowing of Altamaha clay, and small tractors are used to some extent for farm operations throughout the rest of the county. On the sand soils back from the coast, many fields are planted for one or two years and are then left to grow up to weeds for a few years.

Very little drainage for agricultural purposes has been attempted, but in a few places, where it has been tried on the Bladen soils, excellent results have been obtained and have demonstrated that it would be very beneficial over a large part of those soils. On the river delta islands in cultivation, ditches have been made about 100 feet apart. These serve as aids in controlling seepage water and are also used for irrigation. In times of prolonged flood stages of the river, pumps are needed to control the seepage water on these islands. In a few places, small areas of the sand soils have been irrigated by overhead systems, supplied mainly from artesian wells. As artesian wells occur throughout the county, this system of irrigation should greatly facilitate the utilization of some of the sand soils for intensive cultivation, especially Norfolk, Blanton, and Palm Beach fine sands.

SOILS AND CROPS

The most outstanding feature in connection with the soils and crops of McIntosh County is that only between 1 and 2 per cent of the 277,120 acres is under cultivation. More than 100 years ago this county was one of the richest counties in Georgia. It was heavily forested with a magnificent growth of longleaf pine over the vast areas of sandy land and with various hardwoods in the wetter areas and swamps. Practically all the merchantable timber has been removed.

McIntosh County lies in the low coastal section of Georgia, bordering the Atlantic Ocean. Hence, the land lies at a low elevation with very little relief, the highest elevation in the county being only about 50 feet above sea level. The county is sparsely settled except along the immediate coastal section and in the vicinity of a few small communities in the interior, principally along the railroad.

Large areas of good agricultural soils are included in the Eulonia, Fairhope, Norfolk, and Palm Beach soils, all of which have good or fair natural surface drainage. Extensive areas of the Bladen soils occupy low, nearly flat areas and are saturated with water much of the time, and large areas of Altamaha clay have developed in the first bottoms of Altamaha River. Tidal marsh, bordering the eastern side of the county between the coastal islands and the mainland, extends into the mainland, merges into the swamps, and covers a large proportion of the county. Some of this marshland was cultivated before the Civil War and was later abandoned, because of the change in economic conditions. Recently an effort has been made to reclaim part of the Altamaha clay in the river bottoms. Many of the soils

in McIntosh County compare favorably with the best soils of the flatwoods part of the coastal plain, but they are barred from agricultural use because of poor drainage. Some of the highest and best-drained parts of the county are the areas of fine sand and sand, which are naturally low in the elements of fertility, and such areas can not be profitably farmed under present conditions.

The cultivated land consists largely of small garden plots and small acreages devoted to subsistence crops througout the county, with the exception of areas on the islands in the Altamaha River delta, which are being reclaimed for special crops, a few truck farms, and scattered farms devoted primarily to growing crops for fattening cattle or hogs. Most crop cultivation is supplementary to other activities, such as working trees for turpentine, operating sawmills, or varied work along the coast. A few farms are well equipped, the farmhouses are neat, and the outbuildings are substantial. Along the coast, a small amount of land is devoted to fruit trees, nut trees, and intensively cultivated crops. The islands and immediate coastal section of the mainland constitute the older agricultural sections where most of the land originally under cultivation was located. This was because the only satisfactory means of transportation was by water, until comparatively recent times, and most habitations were located in close proximity to accessible waterways. Also, the highest land of the county was in these locations. In the coastal section of the mainland and on the larger islands, even the deepest sands naturally support an unusually dense growth of vegetation due, probably, to the high moisture content of the atmosphere. The moisture favors the growth of many kinds of crops in these locations, but commercial development has been restricted, owing, in part, to poor transportation and market facilities. At present, few of the islands, except Sapelo Island, are under cultivation, and most of them are uninhabited. On the mainland there is an increasing tendency to establish more homes along the coast on account of the mild climate, beautiful scenery, and present ease of access either on the near-by paved Atlantic Coastal Highway or by water. However, very few commercial crops are grown in these locations although a wide variety of fruit, vegetable, and other crops is being tried experimentally.

In the interior, residences have been restricted to the higher areas where drainage is more satisfactory, but periodic floods, spreading from the Altamaha River swamp, have completely isolated many families, and on a few occasions such floods have necessitated relief by the American National Red Cross. Although some farms are favorably located and accessible at any time, before the greater part of the interior can be satisfactorily developed for agriculture, the flood waters of Altamaha River must either be confined to the swamp or confined in their course across the county. With such flood control, large areas of productive soils could be made available for cultivation.

The county is devoted primarily to the production of naval stores, lumber, coastal fisheries, and allied products. The entire land area, including the accessible tidal marsh, is free range unless fenced, and it is extensively used for range cattle, hogs, and goats. As a whole, the county is at present thinly forested or cut-over land.

The natural vegetation of McIntosh County occurs in five main groups as follows: (1) That on the clay subsoil areas, (2) that on the deep sand soils, (3) that on the coastal border, (4) that on the tidal marsh, and (5) that on the swamp lands. The first group occurs in the western part on the Bladen, Eulonia, and Fairhope soils, where the tree growth is comparatively open, with practically no undergrowth, except here and there a small saw palmetto, but with a fair or good stand of native grasses which make good pasture. The trees are predominantly slash and longleaf pines with an occasional loblolly pine (locally called shortleaf pine), ranging from 1 or 2 trees an acre to 50 or more, but the average is probably less than 10. Scattered cypress also occur on areas having poorer drainage, where few or no pines grow, and on higher areas a few sweetgum, willow oak, southern red oak (Spanish oak), and longleaf pine are intermixed with a somewhat thicker undergrowth of saw palmetto and native grasses.

The dry sand soils, on which the second group grows, occur in a narrow belt in the southwestern corner of the county and throughout the eastern part of the mainland area. They include members of the Norfolk, Leon, and Blanton series, principally. Vegetation on these soils is distinctive in that it is either entirely scrubby or has a thick scrubby undergrowth. Vegetation on the Norfolk soils ranges from a scrubby growth of turkey oak and a few other oaks, scattered saw palmetto, and scattered clumps of wire grass, on the drier areas, to a mixed growth of scattered longleaf pine, loblolly pine, post oak, turkey oak, laurel oak, southern red oak, mockernut hickory, and chinquapin, with scattered clumps of wire grass and saw palmetto on more moist areas or areas nearer the coast. Most of the oaks are small. On typical areas of the Leon soils the vegetation consists of a pure stand of longleaf pine, with a thick undergrowth of saw palmetto, gall berry, huckleberry, and other bushes and scattered clumps of wire grass. (Pl. 1, A.) Vegetation on the Blanton soils is intermediate between that on the Norfolk and that on the Leon soils, in most places consisting of a thick stand of longleaf pine, with scattered small oaks of various kinds, although areas occur on which only scrub oaks grow, as on the Norfolk soils, and other areas support only longleaf pine, as on the Leon soils.

The third group occupies a belt, in few places more than one-half mile wide, on the mainland parallel to the marsh border and on the islands, except in the central part of Sapelo Island and the northern part of Blackbeard Island. In this belt, the tree growth is not characteristic of the different soil types, but the land is covered by a uniformly very heavy growth of large trees and a dense undergrowth, irrespective of the kind of soil. Here holly, magnolia, Spanish bayonet (Yucca), cabbage palm, live oak, water oak, willow oak, laurel oak, southern red oak, loblolly pine, spruce pine, longleaf pine, southern red cedar, mockernut hickory, sweetgum, black gum, tree huckleberry, witch-hazel, dwarf sumac, chinquapin, sassafras, and persimmon grow. Immense grapevines and other vines, with a very thick undergrowth of large saw palmetto, abound in places. The undergrowth is so thick as to render it almost impenetrable where no clearing has been done, but magnificent groves occur where the undergrowth has been cleared.

The fourth group occupies the marshlands, on which a thick growth of salt-marsh grasses abounds, some of which make good pasture. These lands are conspicuous for the absence of all tree growth. In brackish water near the coast and as fresh water is approached, as in the mouth of Altamaha River, there is a dense growth of rushes which gradually give way to tall fresh-water reeds and grasses, principally saw grass from 5 to 8 feet high, in old fresh-water rice fields.

The fifth group occupies swamp areas and wet Portsmouth soil areas in which is a dense growth of cypress, black gum, sweetgum, tupelo gum, green ash, black ash, willow, elm, red maple, mockernut hickory, water oak, willow oak, swamp chestnut oak, swamp white oak, overcup oak, slash pine, pond pine, spruce pine, loblolly pine, poplar, ironwood, magnolia, buttonbush, persimmon, myrtle, hackberry, blue beech, haw, swamp palmetto, swamp bay, red bay, white bay, dwarf sumac, mulberry, and Hercules-club.

Longleaf and slash pines are the principal trees of commercial importance for naval stores and lumber, except in the swamps where mixed hardwoods are of value for lumber. Although there are possibilities of greatly extending the agriculture over most of the county, for a long time to come the principal income will be from forest products and pasture. Over most of the county tree growth is very thin and scattered, and few young pines grow. The income from forest products could be greatly increased by adopting conservative methods of working the trees for turpentine and by protecting the pine seedlings from destruction by fires and livestock. The growth of pasture grasses is very good on the lower-lying soils, especially on those having a clay subsoil, such as the Bladen soils. On the higher sandy soils, grass growth is sparse and consists mostly of wire grass which is of little value when it matures.

The agriculture of McIntosh County consists, mainly, of growing general farm crops for subsistence on any kind of soil which is sufficiently well drained. This is due to the secondary importance of farming and to the remoteness of most sections from markets for cash crops, which encourages a self-sustaining type of farming. A notable exception occurs along the coast, especially in the southern part of the county, where special crops are grown for cash. Throughout all the western part and much of the eastern part, corn (grown for home use) is the dominant crop, and oats, peanuts, velvetbeans, hay crops, rice, potatoes, sweetpotatoes, and sugarcane are grown on small acreages to meet local needs. Cotton is about the only cash crop which has been grown in the western part of the county, and it is reported that little or no profit has been made from it in recent years, owing to lack of facilities for ginning and to infestation with the boll weevil, consequently, the acreage now devoted to cotton is so small and variable as to be of little importance. In the eastern part of the county, small areas of a wide variety of special crops, many grown experimentally, have been grown both for home use and for cash. Some of the residents along the coast have grown a wide variety of fruits for home use, including grapes, persimmons, peaches, plums, pomegranates, grapefruit, Satsuma oranges, pineapple pears, and pecans. The commercial production of truck crops has assumed importance recently in the southeastern part although much of the work is still experimental. On one of the delta islands,

cucumbers, tomatoes, peppers, carrots, beets, cabbage, lettuce, eggplants, turnips, radishes, asparagus, and onions have been grown for market. A substation of the Georgia Coastal Plain Experiment Station has been established on Butler Island at which a valuable series of experiments has been started to determine the best crops, fertilizers, and cultural methods for the soils on the river islands, with prospects that the experiments will be extended to some of the upland soils. Present indications are that winter onions constitute the most profitable crop, although all root crops are reported to make excellent growth. Many fruit crops are also being grown experimentally on these islands, such as Satsuma oranges, lemons, grapefruit, and other citrus fruits, peaches, pears, grapes, dewberries, blueberries, raspberries, strawberries, persimmons, and figs. Another line of experimental work which is reported to have good prospects is the growing of bulbs for market, mainly narcissus and gladiolus; and the propagation of ornamental flowers and shrubs, including roses, Vitex, Viburnum, Pittosporum, Ligustrum (privet), jasmine, gardenia, and Abelia. One grower on an upland soil in this southeastern section ships a large quantity of cabbage plants and produces several truck crops for market.

Athough cultivation has been attempted on practically all soils in the county, the extension of agriculture should be limited to those soils which offer reasonable prospects of success. Some of the soils offer exceptional opportunities for agricultural development if suitable crops are selected and if satisfactory marketing facilities can be developed.

For purposes of comparison of the different soils and for study of their agricultural use and possibilities of development, the soils of the county may be divided into three groups. The first group includes the light-colored well-drained soils; the second group includes the light-colored poorly drained soils; and the third group, the black poorly drained soils. In addition to these soil groups, there is a group of miscellaneous materials consisting of tidal marsh, coastal beach, and swamp.

In the following pages of this report the soils of McIntosh County are described in detail and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in Table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in McIntosh County, Ga*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Norfolk fine sand	13,184	4.8	Plummer fine sand	4,992	1.8
Norfolk sand	2,432	.9	Leon fine sand	24,384	8.8
Blanton fine sand	9,536	3.4	Altamaha clay	6,080	2.2
Blanton loamy fine sand	1,088	.4	Portsmouth fine sand	9,344	3.4
Palm Beach fine sand	2,368	.9	Portsmouth fine sand, high phase	960	.3
St. Lucie fine sand	1,024	.4	Portsmouth fine sandy loam	640	.2
Eulonia fine sandy loam	10,944	3.9	St. Johns fine sand	4,224	1.5
Fairhope fine sandy loam	768	.3	Swamp	36,032	13.0
Bladen fine sandy loam	33,088	11.9	Tidal marsh	74,752	27.0
Bladen fine sandy loam, deep phase	7,936	2.9	Tidal marsh, high phase	3,008	1.1
Bladen sandy loam	2,368	.9	Coastal beach	2,304	.8
Bladen clay loam	13,440	4.8			
Bladen clay loam, swamp phase	12,224	4.4	Total	277,120	------

LIGHT-COLORED WELL-DRAINED SOILS

This group includes Norfolk sand, Norfolk fine sand, Blanton fine sand, Blanton loamy fine sand, Palm Beach fine sand, St. Lucie fine sand, Eulonia fine sandy loam, and Fairhope fine sandy loam. All these soils have light-colored surface soils, ranging from light brown in Palm Beach fine sand to white in St. Lucie fine sand. The subsoils range in color from brownish red through yellow to white, and all, except those of the Eulonia and Fairhope fine sandy loams, are sands to considerable depth. These soils occupy the higher topographic positions so that surface drainage is good. Internal drainage ranges from adequate to excessively free. The soils of this group occur on the mainland, bordering tidal marsh and the Altamaha River swamp, and on the larger islands, although the Eulonia, Fairhope, and Blanton soils also occur in scattered areas throughout the rest of the county. The Norfolk and Blanton soils occur in comparatively large undulating areas, but the Eulonia, Fairhope, Palm Beach, and St. Lucie soils are of very small extent. All the soils of this group are moderately or strongly acid, except the Palm Beach soil which is alkaline to a depth of 20 or more inches.

The agricultural value of the soils of this group differs widely for the different soils. Fairhope fine sandy loam, Eulonia fine sandy loam, and Palm Beach fine sand comprise the best soils in the county, but they are inextensive. They occupy good topographic positions, usually in accessible locations, and are inherently productive. Norfolk fine sand, Blanton fine sand, and Blanton loamy fine sand are extensive soils but are inherently less productive than the first-named soils. However, most areas of these soils, where they are not too dry and leachy, can be rendered more productive by moderate soil building. Norfolk sand and St. Lucie fine sand are too dry, incoherent, and leachy to be used for agricultural purposes and are of little value for forestry or pasture. Most farming operations of the county are being conducted on Palm Beach fine sand, Eulonia fine sandy loam, Fairhope fine sandy loam, Blanton loamy fine sand, and Blanton fine sand, although the larger part of all these soils is in forest of variable density. The crops grown consist principally of corn, with a few other subsistence crops, a wide variety of fruit and garden crops for home use, and a small amount of truck crops for market. The agriculture of the county could be expanded to take all these soils into cultivation, except Norfolk sand, St. Lucie fine sand, and the drier parts of Norfolk fine sand and Blanton fine sand.

Norfolk fine sand.—Norfolk fine sand has a surface layer of grayish-yellow fine sand, from 7 to 10 inches deep, underlain by yellow fine sand which is loose and incoherent and extends to a depth ranging from 40 to 60 or more inches. Near the coast this soil in many places has a darker-colored surface layer than elsewhere and is correspondingly more productive. In places the darker color extends to a depth of 8 or 10 inches, and it is caused by organic matter. Elsewhere, the color is probably due to the influence of decomposed oyster shells, although the soil is neutral or slightly acid in reaction. Another common variation near the coast is a surface layer from 1 to 7 inches thick, which is leached almost white, but the underlying sand is bright yellow.

A, Typical vegetation on Leon fine sand. B, hardpan formation under Norfolk fine sand near Shellman Bluff

Part of this soil occupies areas with rolling surface relief in which the sand is more incoherent and dry and supports a scrub oak growth. Elsewhere it occupies areas of gently undulating relief and supports a heavier tree growth, including post oak, turkey oak, laurel oak, Spanish oak, chinquapin, longleaf pine, loblolly pine, and white hickory, with sassafras bushes around cultivated fields. In most places the undergrowth is scattered and consists of clumps of wire grass and saw palmetto, except along the coastal border where a dense growth, which has been previously described, occurs. A larger percentage of this soil is cultivated than of any other of the more extensive soils. Nearly all general crops, except rice and sugarcane, are grown in small areas. Yields are uniformly light, especially for corn, except in close proximity to the coast. Small garden plots, which are well fertilized and especially where there is overhead irrigation, produce excellent yields of truck and garden produce. Fruit trees of many kinds do well near the coast.

Norfolk sand.—Norfolk sand differs from Norfolk fine sand in the coarser texture of the sand and as a result is more dry, leachy, and incoherent. These characteristics render the soil less productive than the fine sand. None of this soil is cultivated and the present tree growth is similar to that on Norfolk fine sand, but it is more scattered. On account of its dry leachy condition, Norfolk sand offers practically no agricultural possibilities and little possibility for pasture or reforesting.

Blanton fine sand.—Blanton fine sand differs from Norfolk fine sand in that the surface soil is somewhat grayer, and below a depth of 8 or 10 inches the color is very pale yellow to a depth ranging from 15 to 24 inches, where it becomes creamy white. This fine sand is very loose and incoherent when dry. A few areas in which the surface soil is sand rather than fine sand are included with the soil as mapped. In places this soil is intermediate between Norfolk fine sand and Plummer fine sand or Leon fine sand, both in surface relief and soil profile. In such areas the subsurface layer of Blanton fine sand is yellow to a depth of 15 or 18 inches where it grades into very pale or creamy-white fine sand which gradually becomes gray and in many places is saturated at a depth ranging from 35 to 40 inches.

A very small acreage of Blanton fine sand is cultivated and is used for general farm crops, principally corn, of which fair yields are obtained in favorable seasons if the land is well fertilized. This soil usually occupies somewhat lower positions than the Norfolk soils but higher than the Bladen or Leon soils, with which it is commonly associated. Tree growth is usually heavier than on either the Norfolk or Bladen soils and in most places consists of longleaf pine, with a small but noticeable intermixture of small hardwood trees. A few areas support a pure longleaf pine stand, and others support loblolly, slash, and longleaf pines, sweetgum, black gum, mockernut hickory, Spanish oak, post oak, water oak, and a fair growth of wire grass and other grasses, together with small saw palmetto.

Blanton loamy fine sand.—Blanton loamy fine sand differs from Blanton fine sand in that mottled gray, light-brown, and yellow light fine sandy loam or sandy clay occurs at a depth ranging from 28 to 40 inches, in most places at a depth of about 30 or 35 inches. A some-

what larger proportion of this soil is cultivated, mostly to corn and general crops. This soil is more desirable for agriculture than Blanton fine sand, and fair crop yields are obtained under favorable conditions. Tree growth is similar to that on the fine sand areas.

Palm Beach fine sand.—Palm Beach fine sand differs from Norfolk fine sand in that the surface soil to a depth ranging from 10 to 20 inches consists of brown or dark-brown fine sand containing a large quantity of partly decomposed fragments of oyster shells. This layer is strongly calcareous. The subsoil layer in most places is similar to that of Norfolk fine sand, although in a few areas it is very pale yellow similar to the corresponding layers of Blanton fine sand. It is usually alkaline in reaction to a depth of 30 or more inches.

This soil occupies areas of high ridgy or hummocky surface relief or, in some places, very slightly undulating areas in close proximity to the coast or on the coastal islands. It is one of the most productive soils in the county and is especially well adapted to legumes. A rather large area is farmed to general crops. On Sapelo Island sweetclover makes an excellent growth. In wooded areas, the soil supports a thick growth of red cedar in addition to a dense growth of all other trees which grow along the coast.

St. Lucie fine sand.—St. Lucie fine sand is very nearly pure white sand from the surface to a depth of 50 or more inches. It occupies areas of gently rolling surface relief, exclusively on Blackbeard Island. None of the soil is farmed, and it offers little or no agricultural possibilities. It supports a growth of scrub oaks exclusively and offers little possibility for reforestation to profitable trees.

Eulonia fine sandy loam.—Eulonia fine sandy loam has a surface soil of grayish-yellow fine sandy loam from 4 to 7 inches deep, overlying yellow fine sandy loam which extends to a depth ranging from 10 to 18 inches. The subsoil consists of yellow fine sandy clay which in many places is faintly mottled with brownish yellow and gray. This layer ranges from 2 to 6 inches in thickness and grades into mottled and streaked red, brown, light-gray, and yellow heavy tough slightly plastic clay material. A few areas in which the surface soil of fine sandy loam extends to a depth of 30 inches before reaching the yellow fine sandy clay subsoil, are included in mapping, but such areas are few and small.

Eulonia fine sandy loam occupies the higher ridges and knolls within areas of the Bladen soils. It constitutes one of the best agricultural soils in the county but is inextensive and occupies no large areas. Probably less than 10 per cent of the land is cultivated, but a larger percentage is farmed than of any other soil in the western part of the county. It has good drainage and is productive. The crops grown include all the general crops (except rice) produced in the western part of the county. A fertilizer demonstration plot on corn was started in 1929 by the Georgia State College of Agriculture on this soil, and this should yield some valuable information. Forested areas support a thick growth of longleaf and loblolly pines, together with an occasional willow oak and southern red oak, but few hardwoods grow. Many areas support a thick undergrowth of sweetgum, especially near swamps, some scattered saw palmettos, and a thick growth of wire grass and other grasses. All this soil is worthy of cultivation and offers the best possibilities in the county for general agriculture.

Fairhope fine sandy loam.—Fairhope fine sandy loam has a brownish-yellow fine sandy loam surface soil extending to a depth ranging from 5 to 18 inches, where it passes into the red or brownish-red clay subsoil which is somewhat plastic when wet but hard and brittle when dry. Exposed cuts in this red clay weather into a fine-granular mass. This layer is usually very thin, in few places exceeding 3 inches in thickness, and it passes below into heavy red clay having faint mottlings of gray and yellow, the mottlings becoming brighter and more varied with depth. In many places faint mottlings extend through all the subsoil layers, and the subsoil may be so close to the surface that the plow turns up red clay in spots over a cultivated field.

Fairhope fine sandy loam is the only "red soil" in the county and commonly occupies slopes in close association with the Eulonia and Bladen soils, in many places lying between the two. This soil occurs only in small areas and is of small total extent in the county, but a large proportion is farmed similarly to Eulonia fine sandy loam which it resembles in agricultural value and possibilities. Tree growth is similar to that on the Eulonia soil.

LIGHT-COLORED POORLY DRAINED SOILS

This group of soils includes Bladen fine sandy loam, Bladen fine sandy loam, deep phase, Bladen sandy loam, Bladen clay loam, Bladen clay loam, swamp phase, Altamaha clay, Plummer fine sand, and Leon fine sand. All these soils are periodically poorly drained on the surface, owing to their low position and little or no variation in surface relief. Poor drainage conditions in Leon fine sand are augmented by the organic hardpan layer. All have light-colored surface soils—steel gray or light gray—although brown mottlings give a brown appearance to Altamaha clay. All the subsoils are gray, more or less mottled with brownish-yellow, except the subsoil of Leon fine sand in which a dark-brown or black hardpan layer occurs. All these soils range from moderately to strongly acid.

Soils of this group occupy the greater part of the county, but only a very small percentage of them is farmed. None of the Plummer soils and only a few spots of the Leon soils are farmed. Most of the Altamaha clay was in rice fields at one time, but at present none is cultivated, except on Butler and Champney Islands. The Bladen soils are the most extensive soils in the county, but only small scattered areas are cultivated. Most of the soils of this group are thinly forested since the land has been cut over, and little care has been given to reforestation except in scattered comparatively small areas.

The best pasture soils occur in this group, the Bladen soils, especially, supporting a good growth of native grasses. The large extent of these pasture soils accounts for the large number of range cattle in the county. The extent of the soils of this group has been the primary influence in determining the type of agriculture or lack of agriculture over most of the county, and any extensive agricultural development must be determined by the uses to which these soils can be adapted. The extent of these good pasture soils should favor the development of more extensive and more efficient livestock industries. It would be impractical to bring the Plummer and Leon soils into cultivation, on account of their low productivity, but Altamaha clay and the Bladen soils prove highly productive

where excess water can be satisfactorily controlled. The Bladen soils are especially desirable for tillage, but drainage conditions over a large part of the county will have to be greatly improved before cultivation would be practical. Not only is drainage somewhat slow over much of these areas, on account of their topographic position, but flood waters from Altamaha River cover large areas about three or four times every five years. If the flood waters can be controlled, large areas of these productive soils can be made available for tillage.

Bladen fine sandy loam.—Bladen fine sandy loam is the most extensive soil in the county. Where cultivated, it has a light-gray fine sandy loam surface soil which extends to a depth ranging from 6 to 20 inches, but in most places ranges from 8 to 15 inches in depth. The subsoil consists of mottled light-gray and brownish-yellow heavy plastic clay which becomes rust brown on exposure and can be broken only with great difficulty when it is air-dry. It extends to a depth ranging from 25 to 40 inches where it grades into very light gray, mottled or streaked with brownish yellow, clay which is plastic but contains a noticeable amount of fine sand. Included with the fine sandy loam as mapped are a few areas, especially in the southwestern part of the county, in which the surface soil is loam.

Only a very small proportion of the land is cultivated, mainly to corn, of which good yields are obtained in favorable seasons. This is one of the better-drained soils of the series, but most of it needs surface drainage for satisfactory cultivation, and most of it occurs sufficiently high above surrounding soils that this can be accomplished, but the danger from floods is too great for extensive cultivation. Inherently it is one of the most productive soils and supports a good growth of native grasses, and will produce an excellent growth of carpet grass, Lespedeza, and Bermuda grass for pasture. It is one of the best soils in the South for the production of potatoes. The tree growth is longleaf and slash pines, principally, with scattered cypress on the wetter areas. Most of the tree growth is very scattered because the pine seedlings have been destroyed by livestock and by frequent fires, but where the trees are protected an excellent forest growth is produced.

Bladen fine sandy loam, deep phase.—Bladen fine sandy loam, deep phase, differs from Bladen fine sandy loam in the depth of the surface soil. The fine sandy loam layer extends to a depth ranging from 20 to 35 inches before reaching the heavy plastic clay subsoil. Areas of this deep soil commonly occupy slightly higher elevations than the typical fine sandy loam, in many places occurring as slight ridges and knolls. The surface soil is also somewhat lighter in color than the typical soil, especially below a depth ranging from 8 to 15 inches, where in many places it becomes very light gray or nearly white. In a few scattered areas, especially near Warsaw, small areas of Bladen sandy loam, deep phase, and of Bladen coarse sandy loam, deep phase, are included in mapping. In some small areas a noticeable proportion of red mottlings occurs through the subsoil. In the northwestern part of the county, many small cypress ponds, too small to show on the map, are included in areas of this soil.

Practically none of the land is cultivated, but much of it supports a slightly thicker growth of pines than the typical fine sandy loam,

with a poorer growth of native grasses. Higher parts of the soil are slightly better drained and hence could be cultivated better than areas of the typical soil, but other large areas, such as occur in the northwestern part of the county, somewhat resemble Plummer soils in their characteristics, with attendant low agricultural possibilities.

Bladen sandy loam.—Bladen sandy loam differs from Bladen fine sandy loam in that the texture of the surface soil is coarser, containing more sand grains in proportion to the fine sand. None of this soil is cultivated but supports a tree growth similar to that on the fine sandy loam. It is of somewhat lower value for agriculture and supports a thinner growth of pasture grasses; otherwise, the problem of its utilization is similar to that of the fine sandy loam.

Bladen clay loam.—Bladen clay loam has a 4 to 8 inch surface soil of dark-gray heavy clay loam, overlying a heavy plastic clay subsoil similar to that under Bladen fine sandy loam. Most areas of Bladen clay loam occupy slightly lower positions than areas of Bladen fine sandy loam, but in a few notable exceptions the clay loam occupies comparatively high flat areas.

A few small areas of this soil have been used for rice growing, but practically none are now in cultivation. This soil would prove very productive under cultivation, but it is one which would be more difficult to till than the fine sandy loam and one on which the control of flood water would be more difficult. A few areas support a tree growth of scattered cypress, but most of the land is occupied by a comparatively thick growth of slash pine, longleaf pine, pond pine, loblolly pine, willow oak, post oak, laurel oak, water oak, red oak, sweetgum, black gum, tupelo gum, and green ash. If the hardwoods are removed, most of the areas will support a thick growth of slash and longleaf pines.

Bladen clay loam, swamp phase.—Bladen clay loam, swamp phase, differs from typical Bladen clay loam in that it occupies lower wetter positions. It occupies depressions throughout the western half of the county, in which water collects and stands for a long time. Part of the swamp phase occupies scattered isolated depressions, but most of it occurs in long narrow meandering strips through which flood waters move to large swamp areas, although in most places no established drainage channel has been developed.

Soil of the swamp phase supports a thick tree growth including cypress, sweetgum, green ash, black willow, elm, red maple, blue beech, water oak, willow oak, swamp chestnut oak, haw, myrtle, persimmon, and swamp palmetto. This land offers little agricultural possibilities with the possible exception of the production of rice in small areas, and it is through these areas that drainage ways should be opened in order to drain the surrounding soils.

Plummer fine sand.—Plummer fine sand has a surface soil of gray fine sand, from 5 to 10 inches deep, which, in some places, has a slightly loamy feel. The surface soil grades into bluish-gray or dark-gray fine sand which is usually saturated and which extends to a depth ranging from 30 to 40 inches where it grades into grayish-white permanently wet fine sand. In some areas, especially on Blackbeard Island, the surface soil passes directly into light-gray fine sand which extends to a depth of 3 feet or deeper and is permanently saturated. In a few areas the texture is sand rather than fine sand. Water stands at or near the surface for long periods.

None of this soil is cultivated, and it offers little possibility of practical development, because of the difficulty of drainage and the inherent low productivity of the land. The loose sand fills ditches and drainage ways in a short time. Most areas of this soil will produce fair pasture grasses. The tree growth varies from a few scattered cypress to scattered mixed cypress, pond pine, slash pine, and in places longleaf pine.

Leon fine sand.—The surface soil of Leon fine sand consists of gray fine sand extending to a depth ranging from 5 to 8 inches, below which is very light gray fine sand which is loose, incoherent, and nearly white when dry. This layer extends to a depth ranging from 15 to 28 inches, where it rests on a dark-brown or black hardpan layer from 6 to 15 inches thick, consisting of fine sand cemented by organic material The darker color occurs at the top of the hardpan layer and lighter brown at the bottom. Underlying the hardpan layer is light-brown fine sand which grades into gray fine sand that is usually saturated. Some variations occur in the surface soil, areas of sand and a few small areas of coarse sand being included with Leon fine sand in mapping. In places in the lower-lying areas, the surface soil, to a depth ranging from 1 to 3 inches, is almost black, owing to organic matter. In such areas the hardpan layer is less indurated. In a few places, mottled gray, yellow, and brown heavy fine sandy clay is present at a depth ranging from 25 to 34 inches below the surface, and, where underlain by this clay, the hardpan layer is only 4 or 5 inches thick, is closer to the surface, and is less hard.

Leon fine sand occupies areas of level or slightly undulating surface relief, lower than the Blanton and Norfolk soils but higher than the Portsmouth soils, with all of which it is closely associated. A very small proportion of the land is cultivated, and crops are very poor except in favorable seasons on the better areas. The hardpan checks the movement of water or moisture through the soil so that the surface soil is saturated for some time following rains, after which it becomes excessively dry and incoherent. In typical areas the natural moisture conditions are not satisfactory to mature a corn crop, but on a few areas, in which the hardpan is deeper and is not so hard as typical and which have been well fertilized or manured, corn is produced in favorable seasons. Pecan trees have been set out on this soil in various places, but the trees do not thrive, regardless of the treatment given them, and they bear few nuts. The soil, as a whole, is not adapted to cultivation. The hardpan layer is very acid and sufficiently hard to inhibit penetration by roots. As a result, even natural vegetation is very restricted as to varieties, with a conspicuous absence of any hardwood growth on typical areas. The land supports a good growth of longleaf pine, except near the coast where longleaf pine is replaced by pond pine, mixed with a few slash pines. Where the soil occurs adjacent to tidal marsh, however, it supports a dense mixed coastal vegetation previously described. The undergrowth on typical areas of Leon fine sand consists of a thick growth of saw palmetto, scattered gall berry and huckleberry, and scattered clumps of wire grass.

Altamaha clay.—Altamaha clay is characterized by a heavy plastic but firm gray clay or silty clay surface soil which is minutely but

abundantly mottled with brown and orange to such an extent that it appears brown at a distance. It extends to a depth of 8 or 10 inches, where the material gradually becomes light gray, with a steady decrease in the amount of mottlings to a depth of 12 or 15 inches, at which depth a bluish-gray soft plastic sticky saturated clay is reached. The clay extends to a depth of 40 or more inches. Although the texture of the surface soil is uniform, considerable variation occurs, both in the color of the surface soil and in the character of the underlying layers. In places, especially on parts of Champney Island, the surface soil, to a depth of 6 or 8 inches, is brown with fine gray mottlings, and in other places the color may be gray with few or no mottlings. Sand strata are reached in places at a depth ranging from 3 to 8 feet, and this is an important condition to be considered in diking or ditching areas of this soil. Seepage water will follow the sand strata under the dikes and rise through "sand boils" wherever the strata come to the surface or where they are reached by ditches. In addition, the remains of trees and marsh grasses, which have disintegrated but little, are present in many places in the subsoil, and they render ditching and diking difficult and in some places seriously interfere with tillage.

Altamaha clay is a low flat first-bottom soil occurring on the islands in the Altamaha River delta. The boundaries between it and the upstream river swamp or the tidal marsh toward the ocean are arbitrary. It includes most but not all of the old rice fields. The land is subject to frequent overflow both by flood waters of the river and by very high tides, except where protected by dikes. Most of this soil was originally planted to rice, but most of the old rice fields have been abandoned and the dikes have been broken.

Recently a substation of the Georgia Coastal Plain Experiment Station has been established on this soil on Butler Island, and intensive cropping to truck crops, bulbs, and fruits has been started on Butler and Champney Islands. The work so far has been experimental, but indications are that these islands can be used profitably for some of the crops mentioned. The original tree growth was similar to that on the river swamp, but the old rice fields support no tree growth, only a tall growth of fresh-water rushes, reeds, and grasses, principally saw grass.

This is one of the strongest soils and perhaps, inherently the most fertile soil in the county.

BLACK POORLY DRAINED SOILS

This group includes Portsmouth fine sand, Portsmouth fine sand, high phase, Portsmouth fine sandy loam, and St. Johns fine sand, all of which have black surface soils, owing to an accumulation of partly decomposed organic matter, extending to a depth of 8 or more inches. The soils of this group occupy low poorly drained areas which have a naturally high water table at all times. Where areas of the Portsmouth soils have been drained, they have been successfully used for pasture and could be used for many other crops, but St. Johns' fine sand is of little agricultural value, because of the organic hardpan layer underlying the surface soil, which is similar to that underlying Leon fine sand. All the soils of this group support a dense vegetation of water-loving trees, shrubs, and vines.

except on a few scattered grassy or savanna areas. These soils occur exclusively in the eastern part of the county, in close proximity to the coast, and on the islands.

Portsmouth fine sand.—Portsmouth fine sand has a surface soil of black fine sand which has a loamy feel, caused by organic matter. The surface soil extends to a depth ranging from 10 to 20 inches and in some places deeper, where it passes into gray or dark-gray saturated fine sand. In a few areas the surface layer, to a depth of 10 or 15 inches, is distinctly peaty and contains very little fine sand.

This soil occupies depressions occurring both as large flat depressions only slightly lower than the surrounding soils and as long narrow, more or less continuous low strips through which excess water moves to the swamps or to the coast, but through which naturally established drainage channels are few. Most of the areas are covered by water to a slight depth during the rainy season. In the past, ditches have been dug, leading from some of the larger areas, to supply water to the old rice fields on the marshlands, and a few areas have been drained for the eradication of mosquitoes. The water in these areas is conspicuously dark colored but clear, in marked distinction to the red muddy water of Altamaha River or the blue salt water in the tidal marsh.

A very small proportion of this soil has been drained and cultivated to garden crops, and a small acreage, mainly on Sapelo Island, has been used for rice. Carpet-grass pastures have been started on many of the drained savanna areas on Sapelo Island. These areas make good pasture. Where drained, the land will produce corn, garden vegetables, and many truck crops.

Two distinct classes of natural vegetation grow on this soil. In a few places on the mainland and in large areas on Sapelo Island, the soil occupies grassy, treeless savanna areas on which shallow water stands for long periods. In other places it supports a very dense mixed growth of trees, shrubs, and vines, including cypress, slash pine, pond pine, magnolia, water oak, live oak, white ash, sweetgum, black gum, swamp bay, sweetbay, white bay, red bay, myrtle, dwarf sumac, mulberry, and Hercules-club.

Portsmouth fine sand, high phase.—Portsmouth fine sand, high phase, differs from Portsmouth fine sand in its slightly higher elevation, with resultant better surface drainage and with a lower water table at all times. On about one-quarter of the areas of this soil, the surface soil is very dark gray or dark brownish gray and the underlying sand is more creamy white than in typical Portsmouth fine sand. This soil occurs principally on Sapelo Island, and it is used for general sustenance crops, principally corn. About two-thirds of the land is cultivated, and the remainder supports a tree growth similar to that on St. Johns fine sand.

Portsmouth fine sandy loam.—Portsmouth fine sandy loam differs from Portsmouth fine sand in that gray heavy fine sandy clay is present at a depth ranging from 10 to 25 inches. In places the black surface soil rests directly on the sandy clay subsoil, and in other places a layer of gray sand, from 2 to 10 inches thick, intervenes. Included with this soil as mapped are areas in which the surface soil is distinctly heavier in texture, being loam or clay loam, and the black color extends to a depth of 3 feet or deeper. Such areas usually border tidal marsh.

This soil is very poorly drained and in many places is kept permanently wet by seepage water from springs. None of the land is farmed, but it supports a dense growth similar to that on Portsmouth fine sand. It would prove fairly productive if surplus water could be controlled.

St. Johns fine sand.—The surface soil of St. Johns fine sand consists of black fine sand which extends to a depth ranging from 10 to 24 inches, where it is underlain by a black indurated organic hardpan layer similar to that underlying the Leon soils. In places, a layer of gray fine sand, ranging from 2 to 8 inches in thickness, intervenes between the black surface soil and the hardpan layer, and in many places the hardpan layer is not so hard as that underlying the Leon soils. Dark-gray fine sand underlies the hardpan layer.

St. Johns fine sand lies somewhat lower than Leon fine sand but slightly higher than Portsmouth fine sand, with both of which soils it is closely associated. A small part of this soil is cultivated, mainly to garden crops. Areas in which surface water can be controlled and in which the hardpan lies at sufficient depth, offer better agricultural possibilities, especially for corn and garden crops, than the Leon soils, but, as a whole, the hardpan makes this soil undesirable for extensive cultivation. The tree growth on mainland areas consists mostly of pond pine and slash pine, and a dense undergrowth of gall berry, other bushes, and small saw palmetto abounds. On Sapelo Island, where most of the soil occurs, the vegetation is similar, except for the absence of slash pine and the ranker growth of saw palmetto. This soil can be reforested to slash and longleaf pines, which are most desirable for either lumber or turpentine.

MISCELLANEOUS SOIL GROUP

The miscellaneous classifications include swamp, tidal marsh, tidal marsh, high phase, and coastal beach. At present, none of these is used for agriculture. Coastal beach is strictly nonagricultural, and swamp and tidal marsh offer very restricted possibilities and should not be utilized until the more extensive better agricultural soils have been reclaimed.

Swamp.—Swamp includes the larger areas of wet lands which are inundated periodically and which are wet during the greater part of the year if not all the time. The lower part of the Altamaha River swamp consists of Altamaha clay and the upper or western part, of brown Congaree material. This swamp is cut by numerous sloughs and small streams and includes many small islands and ridges of sandy material, which are not above extreme high water. Along the margin of the swamp, especially along the lower or eastern part, peaty areas occur in places under a thin layer of gray clay. A few large areas of the river swamp, especially along Cathead Creek, have been planted to rice, and smaller areas have been used in the production of corn in the past, but none of the land is now cultivated. The rest of the swamps of the county consist mainly of gray heavy plastic clay soils merging, toward the coast, into tidal-marsh clays and, toward the upland, into the swamp phase of Bladen clay loam. Small elevations occur within the larger swamps, most of them consisting of small islands of Bladen, Plummer, Blanton, or Leon soils, and near the coast swamp includes the various

members of the Portsmouth series. Areas in these swamps have been used in the past for the production of rice, but no swamp land is now cultivated.

Tidal marsh.—Tidal marsh has a surface layer of mottled reddish-brown and gray heavy moderately firm plastic clay from 3 to 5 inches thick. It is underlain by bluish-gray clay which is soft, saturated with salt water, and in most places contains many whole or only partly disintegrated marsh-grass remains. On small areas close to the coast, especially on necks extending into the upland, a thin layer of fine sand covers the surface soil in many places. In the northeastern part of the county, some of the necks of marshland consist largely of fibrous peat to a depth ranging from 4 to 5 feet. This peat consists of partly disintegrated marsh grasses and rushes. The marshland is entirely or very nearly covered by salt water daily, and it supports a vegetation of salt-water rushes and grasses exclusively, with absence of any tree growth. When rice was an important crop, areas of marshland near the coast were diked and rice was grown by carrying fresh water to the fields by canals from fresh-water swamps. No marshland is now under cultivation, but some of it is used as pasture for cattle and hogs.

Tidal marsh, high phase.—Tidal marsh, high phase, comprises areas closely associated with tidal marsh, but which lie sufficiently above the influence of salt water to allow a normal high-land vegetation. The soil usually consists of intricately mixed Leon, Plummer, Blanton, Palm Beach, and Portsmouth soils, in places with heavy clay occurring at a depth ranging from 2 to 3 feet below the surface. None of this land is cultivated, but most of it supports a growth of red cedar, live oak, pond pine, rushes which will grow in brackish water, and some coarse grasses which furnish scant pasturage for cattle.

Coastal beach.—Coastal beach includes the wide hard smooth sand beaches and the adjacent areas of hilly loose incoherent drifting dune sand on the ocean side of Wolf, Sapelo, Cabretta, and Blackbeard Islands. The beach sand supports no vegetation, but the dune sand supports in places scattered clumps of red cedar, Spanish bayonet (Yucca), and a few other shrubs.

SOILS AND THEIR INTERPRETATION

McIntosh County lies in southeastern United States in the southeastern part of Georgia, in the flatwoods part of the coastal plain bordering the Atlantic Ocean It lies in the gray-soils region, although no mature soils occur in the county. The county offers a rather unusual opportunity for studying the changes which take place in both sands and clays in successive periods of alteration, from the youngest deposits of sand and clay materials to those soils in which horizons have begun to develop.

The soils may be grouped into the sand soils and the clay soils, a grouping which separates not only the soils but also the vegetation and the character of the agriculture The sand-soil group comprises all the soils in which sand or fine sand extends to a depth ranging from 3 to 4 feet or deeper, including soils of the Norfolk, Blanton, Palm Beach, Leon, St. Johns, Portsmouth, Plummer, and St. Lucie

series and coastal beach. The clay-soil group comprises those soils having a clay B horizon, or which consist entirely of clay from the surface downward, and includes soils of the Bladen, Eulonia, Fairhope, and Altamaha series and tidal marsh.

Very little organic matter has accumulated in the surface soil of any of these soils except in the Portsmouth and St. Johns soils, where it has accumulated under poor drainage. In most places, within 1 or 2 inches of the surface is a small accumulation of partly disintegrated organic matter which is mixed with the surface soil but has not become incorporated as part of the soil. Possible exceptions to this are the Bladen soils, in which the dark-gray color of the A horizon may be due in part to incorporated decomposed organic matter held by the heavy clay under slow drainage, and Palm Beach fine sand, in which organic matter has become incorporated in the surface layer under conditions of decomposition in an alkaline medium. In the sand group the organic matter is leached downward as rapidly as it decomposes, owing to the high rainfall on the loose sand, except where the water table is close to the surface. Where the vegetation has been sufficient to produce an appreciable amount of organic matter, the organic matter has been carried down in solution and a precipitation has occurred in a zone of concentration at, or just above, the water table, giving rise to a black indurated impervious hardpan layer. Where the hardpan is comparatively close to the surface (within 30 inches), it constitutes one of the distinctive features in two series separations—the Leon and the St. Johns. On most of the sand soils the vegetation does not produce much organic matter, but a marked exception occurs close to the coast on the mainland and on the coastal islands where the heavy growth of vegetation has left a rather large amount of organic matter in the surface horizon of all the upland soils. Here the decomposed organic matter has been carried down and in many places has been precipitated as a thick hardpan formation at a depth ranging from 5 to 10 feet below the surface of the well-drained sands. Such a hardpan has been observed under some of the Norfolk and Blanton soils near the coast, as well as under the Leon and St. Johns soils. This hardpan layer can be seen at various places where marsh rivers have cut into the upland soils along the coast, and where large blocks resembling bowlders, some of which are 4 feet in diameter, break off along the water's edge. Deep auger borings also have located the hardpan layer under Norfolk fine sand on Brewers Neck, a mile from the nearest coast.

A few preliminary investigations have been conducted at the Georgia State College of Agriculture to determine the character of the hardpan material. It has long been known that ordinary burning destroys the cementing material, leaving a white incoherent sand residue which demonstrates that the cementing agent is organic. It has been proved that the organic material is soluble and that a white sand residue is left by leaching the hardpan with ammonium hydroxide. If this ammonium hydroxide solution is boiled to dryness a shiny black granular residue, which is soluble in water, is left. The hardpan can be re-created by pouring the alkaline organic solution on top of a sand column and bringing an acid solution into contact with it from the bottom, the hardpan developing

where the two solutions come in contact. These are only preliminary investigations but are indicative of the character of the hardpan layer.

A miniature organic concentration, or brown stain, occurs in places in the surface layer of the Norfolk and Blanton fine sands along the coast. In undisturbed areas, about a 1-inch layer of nearly black fine sand, in which the color is caused by organic material, covers the surface in many places. This rests on a 1 or 2 inch layer of white fine sand, and this, in turn, rests on about a 1-inch layer of dark-brown slightly cemented fine sand which grades abruptly into the bright-yellow fine sand typical of the Norfolk soils. This slight concentration is not due to a high water table but to some other condition, as the water table lies at a depth ranging from 5 to 10 feet in Norfolk fine sand.

In Palm Beach fine sand the alkaline condition, caused by decomposing oyster shells, has held the organic matter to a larger extent than in any of the other well-drained sand soils, so that a dark-brown color has been imparted to the surface soil to a depth ranging from 10 to 20 or more inches. This is the only sand soil in which decomposed organic matter has become incorporated as part of the surface soil.

McIntosh County was originally forested with longleaf pine on the well-drained and also on the poorly drained uplands, and a large variety of hardwoods grew in the swamps and poorly drained areas. On the coastal border there was a dense growth of live oak, water oak, willow oak, laurel, red cedar, white hickory, holly, magnolia, and cabbage palms; on the dry sandy ridges the pine growth was more scattered and of a more scrubby character; and on the flat sand areas, where an organic hardpan layer developed, a thick undergrowth of saw palmetto was characteristic. With a vegetation of this character in a hot climate little opportunity has been afforded for the accumulation of organic matter in the soils.

The following three general classes of material of recent geological formations occur in McIntosh County: The deep deposits of fine sand and sand, unconsolidated beds of heavy sandy clay and clays of marine origin, and heavy clays and silty clays of alluvial origin. The sand group occupies largely the eastern borders of the county and the islands. Apparently the deep sand deposits have changed but slightly, except in isolated areas and over some areas undergoing the formation of an organic hardpan layer. The differences in drainage have caused differences in vegetation and also in the amount of leaching, and these have influenced the color of the soils. The sand deposits are underlain at a depth ranging from 5 to 10 feet or more by mottled gray and yellow fine sandy clay material. These deposits give rise to soils of the Norfolk, Blanton, Palm Beach, St. Lucie, Leon, St. Johns, Portsmouth, and Plummer series.

The beds of unconsolidated sandy clays and clays are developed mainly in the western half of the county. Owing to poor drainage, aeration, and lack of oxidation, much of the material has undergone little change, except in color and in slight eluviation in the immediate surface soil, since it was laid down by the sea or river. These deposits give rise to the Bladen soils. Where natural drainage has

developed and aeration and oxidation have been effective, the beginning of a profile development has taken place and, as a result, the Eulonia and Fairhope soils have developed.

Large areas of alluvial material, washed from the piedmont and coastal plains regions, have been deposited in the Altamaha River bottoms, and new material is constantly being added at each heavy overflow. In many places this material grades imperceptibly into tidal marsh.

The soils of the county are all very young, when considered as to normal profile development or soil maturity. The Fairhope and Eulonia soils are the only two soils of the county which show a slight beginning of a distinct, but immature, B horizon. These soils may be considered the most mature in the county, and, although the B horizon is very thin, it is a distinguishing feature of these soils and differentiates them from the soils which have only the A and C horizons.

The Bladen soils are the most extensive soils of the clay group. Bladen fine sandy loam is the predominant soil mapped.

A characteristic profile of Bladen fine sandy loam, as observed in a virgin area 1⅓ miles northwest of Townsend, shows the following layers: A_1, from 0 to 5 inches, is dark-gray mottled with rust-brown fine sandy loam, in which the mottlings are small and inconspicuous but in places are very bright and marked. This layer contains much partly disintegrated organic matter and is the zone of most grass roots. A_2, from 5 to 12 inches, is light-gray fine sandy loam, with brownish-yellow mottlings and containing a few coarse roots. B_1, from 12 to 30 inches, is mottled light-gray and brownish-yellow heavy plastic clay. Old root holes are filled with infiltrations of bluish-gray fine sandy loam. When exposed and dried the clay becomes rust brown, and it flakes on the surface into a fine granular mass. Air-dry lumps can be broken only with difficulty and can not be crushed with the fingers. B_2, from 30 to 52 inches, is very light-gray, mottled with brownish yellow and light green, very plastic clay, carrying a large amount of fine sand. Along some of the breakage lines a green or bluish-gray color is apparent. When air-dry the material in this layer breaks more easily than that in the B_1 layer, but it can not be crushed in the fingers. C_1, from 52 to 80 inches, when moist, is light-green heavy slightly sticky fine sandy loam containing a noticeable amount of fine mica scales. Layers of clay and lenses of fine sand occur. When the material is dry, the color is mottled gray and drab, with stains of yellow and brown. The dry soil can be crushed by the fingers with great effort. In places, dark-green glauconitic material, in pockets of different sizes but with no uniformity of occurrence, is present under this layer. Such material is not usual but was found at different depths in several widely separated areas of the soil.

The Eulonia soils, which occur in close association with the Bladen soils but in slightly higher better-drained positions, comprise a more mature soil series, in which better oxidation has accompanied the development of the horizons. Only one member of the series, the fine sandy loam, is mapped in McIntosh County.

A profile of a typical virgin area as observed at Daniel Grove Church shows the following layers: A_1, from 0 to 4 inches, is gray

fine sandy loam containing much organic matter and many grass roots; A_2, from 4 to 14 inches, is yellow friable fine sandy loam; B_1, from 14 to 18 inches, is yellow, faintly mottled with brownish-yellow and whitish-yellow spots, fairly friable fine sandy clay in which air-dry fragments are easily crushed; B_2, from 18 to 21 inches, is yellow, mottled with light red and light gray, heavy fine sandy clay, in which air-dry fragments are crushed with moderate ease; C_1, from 21 to 54 inches, is mottled and streaked red, brownish-red, and light-gray, with different shades of yellow, heavy tough slightly plastic clay material, in which the red streaks and spots are very friable but the gray part is smooth and slightly plastic, having a soapy feel; and C_2, from 54 to 80 inches, is material which is lighter red and more friable than in the C_1 layer, and in which streaks of light-yellow very friable material are intermixed with streaks and layers of mottled gray, yellowish brown, and buff, some of which are very sandy. The B_1 layer ranges from 2 to 6 inches in thickness and in many places shows no trace of mottlings.

The Fairhope soils are characterized by a red B horizon of heavy clay. Fairhope fine sandy loam is the only member of the Fairhope series mapped in McIntosh County and it is the only red soil in the county.

A virgin area 1¼ miles southeast of Eulonia has a typical profile as follows: A_1, from 0 to 2 inches, is dark-gray fine sandy loam in which the dark color is due to organic matter, containing many roots. A_2, from 2 to 9 inches, is brownish-yellow fine sandy loam, containing many small roots. B_1, from 9 to 12 inches, is brownish-red clay which is somewhat plastic when wet. The red color is uniform on a cut surface, and the broken surface of lumps is shiny. The material on an exposed surface breaks into lumps on becoming dry and finally into a fine-granular mass. Air-dry lumps tend to polish rather than to crush, but they can be crushed by the fingers with extreme difficulty. B_2, from 12 to 25 inches, is dull-red, faintly mottled with gray and yellow, somewhat plastic clay. The material on an exposed surface breaks into lumps and finally into a fine-granular mass, and the broken lumps are shiny on the surface. Air-dry lumps tend to polish when crushed but can be crushed with considerable difficulty, though somewhat more easily than the material of the B_1 layer. C, from 25 to 40 inches, is mottled and streaked light-gray and red, with stains of yellow, clay material which is brittle but slightly friable and breaks into angular blocks showing a slight lamination in some places. The outsides of gray blocks have shiny surfaces with a yellow stain, and the interiors of the gray blocks are usually red. The gray part is smooth clay and the red is friable very fine sandy clay. In places alternating streaks of red and gray extend at different angles. Below a depth of 40 inches the gray color increases and the red diminishes. The material of the B_1 layer shrinks greatly on becoming air-dry. A natural block of the moist material of this layer was allowed to dry for three weeks until shrinkage ceased and then tested for further shrinkage in a water-jacketed oven. A block of 150 centimeters long shrank to 136 centimeters, a shrinkage of 9.3 per cent, on air-drying. Molded bricks of the same material shrank as much as 15.8 per cent on air-drying.

The only other clays in the county are the tidal-marsh clay and Altamaha clay. The tidal-marsh clay has a 2 to 4 inch surface layer of mottled brown and gray comparatively firm clay. It is underlain by gray or bluish-gray clay which is saturated and contains many partly disintegrated marsh-grass remains. Following floods on Altamaha River, the entire marshland area bears a brown surface stain of the clay brought down by the river. This may explain the source of part of the clay material of the marshes if not all. The marsh clay gives an alkaline reaction with Soiltex tests as also does the salt water. This is in marked distinction from Altamaha clay and the water of Altamaha River which react strongly acid.

Altamaha clay on Butler Island has a surface layer of dark-gray, streaked with brown, firm heavy clay, in which wide cracks form in the undisturbed dry material. This layer is underlain by light-gray or bluish-gray saturated clay which is very soft and sticky. In places in ditch banks this clay layer shows a slightly laminated structure. The material has an extremely high shrinkage on drying. A natural brick was allowed to dry slowly in a water-jacketed oven until shrinkage ceased. The natural brick just maintained its shape when trimmed to fit the oven, with an original length of 210 millimeters. When it shrank to a length of 204 millimeters the clay became stiff, and it finally shrank to 161 millimeters, where it remained, a total shrinkage of 23.3 per cent. Some tests were made by the experiment station on Butler Island to determine the rate of movement of water through this soil. In a hole 5 feet from an irrigation ditch, the water rose 14½ inches in 30 hours after the ditch was filled, and it fell 8½ inches in 9 hours after the ditch was emptied. In a hole 45 feet from the ditch, the water rose 3 inches in 30 hours after the ditch was filled and remained stationary for 9 hours after the ditch was emptied.

The sand soils have not developed eluvial and illuvial horizons of fine material, but differ in the degree of oxidation, as shown by their color and by the character and influence of the organic matter contained in them.

The Norfolk sands are characterized by their bright-yellow color. In a virgin area of Norfolk fine sand 1¼ miles west of Shellman Bluff the profile is as follows: From 0 to 4 inches, is gray fine sand carrying a small amount of organic matter, and containing scattered roots; from 4 to 42 inches, is yellow fine sand, which is loose and incoherent, and contains many tree roots; from 42 to 66 inches, is yellow fine sand, with faint mottlings of brownish yellow and light gray, which contains small tree roots; from 66 to 74 inches, is light-gray or slightly brownish gray fine sand; and below a depth of 74 inches, is a dark-brown indurated hardpan layer of fine sand. The hardpan layer is not typical of the Norfolk soils but is present only in several areas close to the coast. (Pl. 1, B.) In most places the sand rests on mottled clay material at a depth ranging from 5 to 15 feet or deeper.

The soils of the Blanton series are differentiated from the Norfolk soils by the light-gray color of the surface soil and the light creamy-white color of the subsoil. The subsoil, to a depth of about 60 inches, contains brown and white splotches throughout. The profile has the appearance of being more leached than that of the Norfolk soils. At

a depth of 60 or more inches, light-colored mottled clay material is present, and, on slopes, the clay material may be conspicuously mottled with red.

Leon fine sand, in a wooded area one-half mile west of Connegan, has a profile as follows: From 0 to 4 inches, is gray fine sand containing much partly disintegrated and partly decomposed organic matter. No leaf mold is on the surface, but the surface soil is filled with grass roots, palmetto roots, and lateral pine roots. From 4 to 23 inches, is very light-gray fine sand which is nearly white when dry, is loose, and incoherent. There is no organic coloration in this layer, but it contains many palmetto and pine roots. It is saturated for a long time following rains. From 23 to 26 inches, is a black cemented impervious organic hardpan layer of fine sand which is dark brown when dry. It contains a considerable number of fine pine tree roots. A sharp line of demarcation separates this layer from the one above, but necks and prongs of the overlying layer extend into the hardpan, giving the hardpan an uneven surface. The change to the underlying layer is gradual. Cementation is sufficient to prevent the movement of water through this layer in either direction. From 26 to 32 inches, brown fine sand, the upper 1 or 2 inches of which is hard and compact, but the material gradually becomes more friable toward the bottom of the layer, and the lower part is light-brown fine sand with a soft mellow feel. Tongues and streaks extend downward into the underlying layer to a depth ranging from 12 to 24 inches. The only roots found are pine tree taproots. From 32 to 48 inches and deeper, is light-gray permanently saturated fine sand containing pine tree taproots.

On the typical mainland areas with a very hard hardpan layer, longleaf pine constitutes the exclusive tree growth. (Pl. 1, A.) Young longleaf pines were dug out during the course of the survey, the taproots of which made one or more "corkscrew" turns before entering the hardpan layer. On island areas of this soil there is noticeably less induration to the hardpan layer and the color in such areas is usually black or very dark brown throughout.

Table 5 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and several layers of the subsoil of Leon fine sand.

TABLE 5.—*Mechanical analyses of Leon fine sand*

No	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*
259001	Surface soil, 0 to 4 inches	0	0.4	2.3	83.3	10.1	2.3	1.5
259002	Subsurface soil, 4 to 23 inches	0	4	1.6	86.2	8.0	2.5	1.2
259003	Subsoil, 23 to 26 inches	0	6	2.1	81.6	10.6	2.7	2.4
259004	Subsoil, 26 to 32 inches	0	4	1.7	81.8	11.1	2.2	2.8
259005	Subsoil, 32 to 48 inches	0	.4	2.0	82.7	13.3	.9	.6

Swamp includes two types of material. The swamp along Altamaha River, in the western part of the county includes Congaree clay material which is reddish brown and more or less silty, whereas that in the eastern part of the county consists of Altamaha clay ma-

terial which is gray and extremely heavy. Elsewhere, swamp includes gray clays which merge into salt marshland on one hand and into the swamp phase of Bladen clay loam on the other.

Coastal beach includes the wide hard sand beaches, bordering the ocean on the coastal islands, and the adjacent areas of loose incoherent dune sand, most of which is wind-blown sand supporting very little vegetation, except scattered clumps of red cedar, saw palmetto, and an occasional Spanish bayonet.

Soils of the St. Johns series differ from those of the Leon series in that the surface layer is black to a depth ranging from 7 to 20 inches, owing to partly decomposed organic matter. The black surface layer may rest directly on the organic hardpan layer, or a layer of light-gray sand from 2 to 5 inches thick may intervene. The hardpan layer in many places is black and a little less indurated than in typical Leon areas.

Palm Beach fine sand differs from Norfolk fine sand in that the material in the surface layer, to a depth ranging from 10 to 20 inches, is brown or dark brown, and it has an alkaline reaction due to partly weathered oyster shells. The alkaline reaction in most places extends to a depth of 3 feet or more into the yellow fine sand subsurface layer. In places the subsurface layer is pale-yellow or cream-colored fine sand.

St. Lucie fine sand is almost pure white fine sand from the surface downward to a depth of 4 feet or more. The sand is nearly pure quartz.

The Portsmouth and Plummer series include the most poorly drained sand soils in the county. Portsmouth fine sand has a black surface soil owing to a high content of organic matter. It is underlain by light-gray fine sand.

Plummer fine sand differs from Portsmouth fine sand in that there is only a small amount of organic matter in the soil, and it consists of gray fine sand in which the water table is close to the surface at all times.

SUMMARY

McIntosh County is situated in the southeastern part of Georgia in southeastern United States. It lies in the flatwoods part of the coastal plain bordering the Atlantic Ocean. The main physiographic features of the county are a series of barrier islands bordering the ocean, which are separated from the mainland by a wide flat area of salt marshland subject to daily flooding by the tide. The southern part of the county includes the wide flood plain of Altamaha River. The remainder of the mainland area consists of a wide low flat plain across the western half of the county, with an elevation ranging from 10 to 20 feet above sea level. This plain is separated from the marsh border, and to less extent from the river swamp by a higher deep sand belt with a broadly rolling surface with little relief, the elevation ranging from 30 to 50 feet.

The soils of the county occur in two general classes—the sand soils and the clay soils. The sand soils occur near the coast and on the coastal islands. Of these, the Norfolk and Blanton soils are the highest and driest, except where they closely parallel the marsh border along the coast, where moisture conditions on all the soils

differ from conditions inland. Palm Beach fine sand is another well-drained sand soil and is the most productive sand soil in the county, owing to its alkalinity. The Leon and St. Johns soils are characterized by an organic hardpan which renders them of little agricultural value. The Portsmouth and Plummer soils are poorly drained sand soils of which only the Portsmouth soils present agricultural possibilities following drainage. St. Lucie fine sand is a nonagricultural soil on Blackbeard Island, and coastal beach is a sand separation bordering the ocean.

The clay soils occur on the plain in the western part of the county, along Altamaha River, and in the tidal marsh. Of these soils the Fairhope and Eulonia are the most mature and have the highest agricultural value of the soils of the county. The Bladen soils are the most extensive and would be highly productive if drained and if the flood waters of Altamaha River could be kept within bounds. Altamaha clay is the first-bottom soil along Altamaha River, much of which was used in the past for rice production but which was abandoned for a long time. Recently, efforts have been made to utilize some of the land for the production of truck crops, fruits, and bulbs. Small areas of tidal marsh also were once used for rice but are now used only for pasture.

Very little agriculture is carried on in the county, only between 1 and 2 per cent of the total land area being in cultivation. The agriculture consists primarily in the utilization of many small areas throughout the county for sustenance crops. In the southeastern part truck crops are being grown. The main enterprises of the county are the production of naval stores, lumbering, and the gathering and marketing of sea food, principally oysters and shrimps.

McIntosh County offers exceptional opportunities for prospective settlers to obtain virgin areas of highly productive soils, capable of producing three crops a year, owing to the long growing season. However, settlement should be restricted to the Eulonia and Fairhope soils, to areas of Bladen soils which can be drained and are protected from overflow of Altamaha River, to the Palm Beach soils, or to areas of Norfolk or Blanton sands which can be irrigated by overhead systems.

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[PUBLIC RESOLUTION—No. 9]

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

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

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

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]

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