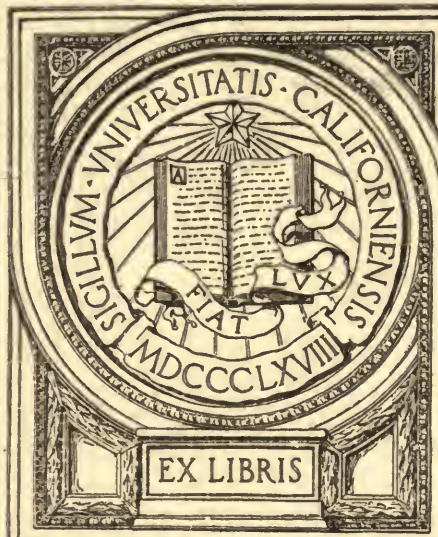

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BUREAU OF SOILS—CIRCULAR No. 21.

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SOILS IN THE VICINITY OF BRUNSWICK, GA.: A PRELIMINARY REPORT.

GENERAL DESCRIPTION OF THE AREA.

In order to determine the character of the soils in the vicinity of Brunswick, Glynn County, Ga., and to ascertain their crop adaptations and capabilities a preliminary survey was made of a considerable territory about that city in October, 1909. No attempt was made to map any of the different areas of soil, owing to lack of time and to the fact that such work lies within the province of the detailed soil survey, by which the location and extent of the different grades of land are shown on a carefully prepared map. It is hoped that a complete or detailed survey of the whole of the county can be made in the near future. In the meantime the descriptions of the several soils given in this circular will be valuable as a guide in identifying the important soils of the county and will go far, it is believed, in directing proper utilization of the soils.

Glynn County is situated in the southeastern part of the State, entirely within the Atlantic Coastal Plain. It has a water frontage of about 20 miles along the Atlantic Ocean and an inland extent of approximately 38 miles. Brunswick, the county seat, is about 57 miles nearly due north from Jacksonville, Fla., and 69 miles a little west of south from Savannah, Ga. The area of the county is 468 square miles, or 299,520 acres.

Topographically the mainland portion of Glynn County is a plain of marked evenness, the surface being interrupted only by slight hummocks with intervening shallow depressions, occasional very low sand ridges, and streamway depressions, which in a generalized view hardly affect the flat appearance of the whole country.

Carefully determined altitudes above sea level show but slight variation in the surface elevation of the county. In different parts of Brunswick the elevation varies from 7 to about 15 feet; at Ster-

ling it is 21 feet, and at Everett City, in the northwestern part of the county, only 16 feet. High sand dunes are of common occurrence near the ocean front.

The seaward portion of the county is much dissected by rivers and arms of the sea. Several large islands, as St. Simons and Jekyl, have been cut off from the mainland by this network of waterways. Fringing these coastal land areas are to be seen in many places monotonously flat stretches of salt marsh covered with a dense growth of rushes and salt grass. The broad bottoms of the Altamaha River are marked along the outer margin by an abrupt bluff. Much of this alluvium has been reclaimed from inundation by diking.

Very little of the upland is farmed, most of it being timbered with longleaf and shortleaf pine, scattering live oak, hickory, and cabbage palmetto and an undergrowth of saw palmetto, gallberry bushes, and wire-grass.

The population of Glynn County in 1830 was, according to the census: Whites, 597; slaves, 3,968; free colored, 2. There was a slight increase during the next twenty years, the population in 1850 being, whites, 696; slaves, 4,232; free colored, 5. The population of the county in 1900 was 14,317, and of these 9,081 lived in Brunswick. The rural population is very much scattered.

Transportation facilities are excellent. Three important railroad systems enter Brunswick—the Southern, the Atlantic Coast Line, and the Atlanta, Birmingham, and Atlantic. Fast refrigerator express freight service to northern markets is available. Brunswick is also an important seaport, having a fine deep-water harbor and good docking facilities.

The dirt roads average very good and are being improved by sand-clay surfacing and the use of shells.

AGRICULTURE.

Settlement began within the territory now included in Glynn County about 1736. In 1765 the boundaries of the county were defined under the name of the parishes of St. Patrick and St. David, and later the territory included was renamed the County of Glynn. As the seat of government for the province of Georgia early hostilities with the Spanish centered about this section.

The production and exportation of indigo, together with an extensive trade with the Indians, was accompanied with marked prosperity and development during the period 1743–1765. Subsequently the Revolutionary war entailed stagnation of the industry, but after 1783 conditions improved rapidly. Sea Island cotton promised to bring high prices, and soon what capital existed or could be borrowed turned to that industry. Large farms were opened for its

cultivation on St. Simons and Jekyl islands, and also on the mainland, especially in the tide-water district and the Big and Little Buffalo swamps.

> Immigrants from South and North Carolina flowed in, and French refugees from the West Indies * * *. Schools were opened, churches built, lands cleared and diked, and by the close of the century the ruins that had marked the course of the war were hid by the growths of peace.[a]

A number of large plantations established along the Altamaha River about the close of the eighteenth century are yet under tillage. The cultivated portion of these consists of the overflowed river bottoms, reclaimed by substantial dikes and skillful ditching. Irrigated by water from the river, excellent rice has been produced continuously up to the present time. A considerable acreage was at first devoted to cotton and sugar cane, but the production of rice soon became the dominant agricultural industry. A sugar mill built on the Hopeton plantation about 1828 manufactured sugar successfully, but finally ceased operations owing to increased attention to the more profitable rice industry. Agricultural operations have been confined principally to the diked river lands since the early part of the nineteenth century, and relatively small areas have been cropped in the uplands since the early abandonment of indigo growing and the later decline and cessation of Sea Island cotton production, which had attained a place of considerable importance in certain sections of the county.

Of a total area of 106,249 acres in farms, only 20,472 acres were classed by the census of 1850 as improved farm land. In 1849 there were produced in Glynn County 3,829,875 pounds of rice, 49,739 bushels of corn, 1,036 bales of cotton, 55,100 bushels of sweet potatoes, 7,290 bushels of pease, 1,470 bushels of oats, and 5,766 gallons of molasses. There has been some decline since this, owing to the fact that considerable effort has been diverted from agriculture toward the naval stores, lumbering, shipping, and other industries. In 1899 of the 77,933 acres in farms 5,593 were classed as improved land. In this year there were made in the county 1,150,460 bushels of rice, 21,570 bushels of corn, 2 bales of cotton, 20,334 bushels of sweet potatoes, 5,331 bushels of Irish potatoes, 991 bushels of pease, 2,651 bushels of oats, and 4,485 gallons of sirup. In addition, 154 acres were planted to miscellaneous vegetables. The value of live stock was estimated at $67,384.

Considerable rice is being produced at the present time, notwithstanding the Louisiana, Texas, and Arkansas growers have a tremendous advantage in being able to harvest with machinery and

[a] Annals and Statistics of Glynn County, Georgia, by Chas. S. Wylly. Acknowledgment is due Mr. Wylly for historical data included in the introductory paragraphs of this chapter.

in being protected from overflows. Under present methods of management only moderate yields of corn, sugar cane, and forage are made, and the average is quite limited. Crab-grass, Bermuda, and "goose grass" flourish on most of the upland types.

A variety of vegetables are being grown quite successfully both in the uplands and on the diked rice fields. Sweet potatoes, Irish potatoes, beans, onions, tomatoes, lettuce, celery, peppers, okra, and a number of other crops have given excellent results. Certain types of the river-bottom lands are especially adapted to a variety of vegetables, while in the uplands there is a considerable area of good truck as well as good general farm land needing only to be handled properly in order to give good yields. With proper effort there is no reason why there should not be built up diversified and extensive agricultural interests, particularly in trucking, as with proper soil selection and management there should be no trouble in growing the crops.

VEGETABLES.

A number of soils encountered in this preliminary survey are adapted to celery, lettuce, and other vegetables. These are quite similar in composition to the sand and muck celery lands of the Sanford (Fla.) district, and handled along the same general lines as pursued in this highly successful trucking section, there is no reason why these crops should not be grown successfully around Brunswick. Soils suited to this crop, as well as to a number of other vegetables, such as cabbage, lettuce, onions, Irish potatoes, etc., are described in succeeding pages.

The general methods of vegetable production as practiced by the Sanford growers is given below, inasmuch as it is believed that the same methods will, in a general way, fit the conditions in the vicinity of Brunswick. Of course it will be necessary to do many things differently around Brunswick, as, for instance, some land here for celery will mainly need drainage and probably little or no added water after the crop is once well started. It is not meant that the fertilizer practices of the Sanford growers should be followed strictly here; in fact, the practices vary considerably in that section to suit the different soils and to accord with individual ideas, and the planting or setting of winter vegetables will in most cases have to be done earlier about Brunswick than is the case in the more southern section.

In the Sanford section imported celery seed is sown broadcast or in drills on well-fertilized beds 3 or 4 feet wide. The young plants are protected from the hot sun either by shading with cloth (a heavier cloth than cheese cloth is used) arranged on peaked wire frames or by parallel slanting slats on the south side of the beds placed north and south to insure an equal distribution of sunlight

upon the plants. To regulate shading under cloth the covering is arranged so that it may be rolled up to the peak wire or let down to the ground at will. Slat shades are sometimes covered with sacks in the middle of the day to protect the tender plants more completely. Moisture is applied by subirrigation. At one time much transplanting to a second seed bed was done, but this is being practiced less extensively at present and is done principally to give room for strong, uniform plant development. This first transplanting is done when the plants are four to six weeks old.

Newly cleared land, with stumps and roots removed, is usually cultivated to Irish potatoes or tomatoes one or two years before planting celery, as the crop seems to give rather poor average results on new ground. Success on new land, however, was reported as following frequent preliminary cultivation, liberal liming, and the application of hardwood ashes.

A ton of lime, floats, or hardwood ashes to the acre is applied to correct acidity, the land harrowed frequently during the summer with acme and cutaway harrows, plowed 6 inches deep, and fertilized broadcast from four to six weeks before setting. The fertilizer is harrowed in and the land later turned 4 inches deep with a turning plow, smoothed with a "planker," and the rows marked off from 26 to 36 inches apart. The plants are hand set from 3 to 4 inches apart in the row, watered individually by hand, and the whole field saturated from below. The rows are set alternately with large and small plants as a means of economy in distributing blanching boards from the rows of early to later maturing plants. The subirrigation system is arranged so that water may be kept at any level above the tiles (12 to 18 inches below the surface). Beginning a day or two after setting the water is gradually drawn off to reduce bogginess and to allow aeration of the soil. Cultivation is begun within a week following setting by stirring the soil 3 or 4 inches from the plants with a hand-pushed, shallow-running wheel plow. After an interval of ten days furrows are run on both sides with a bull-tongue plow to a depth of 6 inches. Weekly horse cultivation is then given until about two weeks preceding banking, when shallow hand-plow cultivation is resumed. The fields are subirrigated at varying intervals, depending upon the season. After the plants are well started not so much water is needed. With the Golden self-blanching variety usually grown, blanching is done by standing boards (cypress boards 1 inch thick and 10 to 12 inches wide) perpendicularly on both sides of the plants and about 10 inches apart, staking them in place. These are moved up slightly at intervals of two or three days until within 6 inches of each other. Blanching requires from ten days to three weeks, according to the weather. With a late crop and warm weather

ten days is sufficient, while five days is generally sufficient for celery intended for cold storage. A few outside leaves are removed, the plants packed, in the rough, directly into crates of standard size and placed in iced cars.

Celery is shipped mainly to eastern markets at any time between Christmas and May, depending on time of planting and rate of growth. March is the heavy shipping month for the Sanford district.

There is considerable variation in the amount, quality, and method of applying fertilizers. Some apply one-half before planting, following with one or two later applications. Sodium nitrate or dried blood is frequently used for the later applications, the former being used in from one to three applications of about 200 pounds per acre each. Castor pomace, cotton-seed meal, kainit, sulphate of potash, tankage, dried blood, phosphoric acid, bone meal, etc., are variously used by different growers, while a number of ready-mixed brands are popular. An average analysis of fertilizers used would show about 6 per cent phosphoric acid, 4 per cent nitrogen, and 7 per cent potash. A frequent acreage application consists of 1 ton of hardwood ashes (which is said to start the crop off well), 1 ton cotton-seed meal or castor pomace, 1 ton high-grade "blood and bone," 300 pounds sulphate of potash, 5 to 20 tons of well-rotted manure (thoroughly rotted by stacking), and from 200 to 500 pounds of sodium nitrate.

The acreage application of fertilizer ranges from about 1½ to 4 tons, not including barnyard manure. Rich hammock land or mucky soil requires less fertilization than the sandy land. The plan in this section is to put on enough fertilizer to meet all possible needs of a crop. No careful experiments have been made to determine the exact effect of various materials or mixtures, or the best quantity to use, the growers being satisfied with the good crops secured under present methods of heavy though somewhat indiscriminate fertilization. It seems to be pretty well established that liberal quantities of nitrogen and potash are required and that the sulphate of potash is decidedly better than kainit. Potash is believed to make celery stand shipment better.

Combinations giving the best growth of celery, according to tests made by the Florida Agricultural Experiment Station (1908 report), were as follows, in order of rank:

(1) Acid phosphate, dried blood, and low-grade sulphate of potash.
(2) Floats, dried blood, and low-grade sulphate of potash.
(3) Floats, fish scrap, and low-grade sulphate of potash.
(4) Floats, nitrate of soda, and low-grade sulphate of potash.

All points considered, including yield, resistance to disease, etc., the following combinations, in order of rank, gave best results:

(1) Bone meal, fish scrap, and high-grade sulphate of potash.
(2) Bone meal, fish scrap, and muriate of potash.
(3) Bone meal, dried blood, and high-grade sulphate of potash.
(4) Floats, fish scrap, and low-grade sulphate of potash.
(5) Acid phosphate, dried blood, and muriate of potash.

The tendency of these tests was to show that where nitrate of soda and kainit are used the plants are more susceptible to blackheart, that bone meal is the best source of phosphoric acid, and that dried blood and fish scrap are the best sources of nitrogen.

Spraying with Bordeaux mixture is very effective in combating blight. Much less trouble, however, comes from this source than blackheart, the greater or less prevalence of which seems to depend, to a certain extent at least, upon the kind of fertilizer used. There has been little trouble from other diseases.

Not infrequently celery is planted with lettuce, but this method is not considered the best by many growers, as the latter crop is sometimes given too much water in the heavy subirrigation given the later-set celery. The better plan seems to be to follow lettuce with celery, in which case less fertilization is needed, as the residual effect of that applied to the former is of considerable account. Relatively less potash is required for lettuce, a 5–5–5 brand being frequently used. About the same materials, however, are used for both crops, but the proportions are varied and the acreage application for lettuce is only about half that used for celery. A number of farmers disk under cowpeas during summer for succeeding crops of celery and lettuce with excellent results.

Good crops of Irish potatoes, tomatoes, and eggplant are secured after celery and heavy yields of crab-grass hay. Cauliflower, Bermuda onions, and cabbage are also grown successfully on subirrigated lands.

For subirrigation 2 or 3 inch tiles laid 15, 20, or 25 feet apart at a depth of about 12 or 18 inches are connected with a main placed along the higher part of the field, into which water from artesian wells flows. The connections are made by a small iron pipe and at these junctions "standpipes" or large tile drains are set upright and connected with the mains so that water connection with the laterals may be controlled with ease. These openings are also convenient for dipping out water to be used on freshly set plants. It is estimated that a 2-inch artesian well will furnish sufficient water to subirrigate a 5-acre field.

The deep sandy land in the vicinity of Brunswick, such as the Amelia sand, on account of its open nature, will require surface irrigation probably by spraying from pipes carried through the fields.

Subirrigation could be made effective on those areas having a good hardpan or the water table at a depth of 18 to 24 feet. There are a number of upland soils, however, in this section suited to subirrigation.

CLIMATE.

The following table gives the normal monthly and annual temperature and rainfall and frost records for Jacksonville and Eustis, Fla., and Savannah, Ga., as a basis of comparing the climate of these regions.

Records covering sufficient time to afford a basis for satisfactory normals could not be secured for Brunswick, but as this point lies nearly half way between Jacksonville and Savannah and at about the same elevation and relative position with reference to the ocean, its climate should be approximately the mean of these two points. Figuring a northerly recession of the frost line at 13 miles a day the season at Brunswick is probably about 4 to 5 days later than at Jacksonville and 5 to 6 days earlier than at Savannah. Killing frosts may not be expected under normal conditions before December 1 nor later than February 24, although there is some variation, these dates representing the average occurrence of killing frosts. Many vegetables can be grown unprotected throughout the winter, and with a covering of cloth all but the most delicate can be grown with reasonable certainty of success throughout the year. The long growing season makes it possible to secure several crops annually from the same land.

The table showing the climatic records of Eustis, Fla., is given for sake of comparison with the famous celery and lettuce district of Sanford, which is 35 miles nearly east from Eustis. The annual winter mean of 60° F. for Eustis shows the climate of this region to be considerably milder than at Brunswick. To balance such inequality, planting of winter crops, such as celery and lettuce, should be done several weeks earlier than at Sanford, and in addition cloth (sheeting) should be kept available for covering in threatening weather. Celery is set in the Sanford district from about October 1 to December 1, and lettuce from September 15 to November 1.

The summers at Brunswick are moderated by sea breezes and are usually quite pleasant, while the winters are in every way delightful.

Normal monthly, seasonal, and annual temperature and precipitation at Savannah, Ga.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	52	80	12	3.2	1.0	5.5
January	51	80	12	3.1	3.6	6.4
February	54	84	8	3.3	4.2	3.1
Winter	52	.....	.....	9.6	8.8	15.0
March	59	88	24	3.7	2.3	3.1
April	66	90	33	3.3	1.9	1.1
May	74	101	44	2.8	2.7	4.0
Spring	66	.....	.....	9.8	6.9	8.2
June	79	100	50	6.1	6.8	8.1
July	82	105	63	5.8	3.7	7.9
August	81	102	61	7.9	6.4	14.4
Summer	81	.....	.....	19.8	16.9	30.4
September	76	97	46	5.7	2.1	12.0
October	67	92	37	3.7	1.0	7.7
November	58	83	22	2.4	1.0	0.6
Fall	67	.....	.....	11.8	4.1	20.3
Year	66	105	8	51.0	36.7	73.9

Average date of last killing frost in spring, February 26, and of first in fall, November 27; date of latest in spring, April 5; and of earliest in fall, November 1.

Normal monthly, seasonal, and annual temperature and precipitation at Jacksonville, Fla.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	56	81	14	3.0	2.4	7.8
January	55	81	15	3.0	4.0	7.2
February	58	86	10	3.4	3.4	5.2
Winter	56	.....	.....	9.4	9.8	20.2
March	63	88	26	3.5	1.4	5.7
April	68	92	34	2.9	3.2	1.2
May	75	98	46	4.0	1.9	7.7
Spring	69	.....	.....	10.4	6.5	14.6

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Normal monthly, seasonal, and annual temperature and precipitation at Jacksonville, Fla.—Continued.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	Inches.	Inches.	Inches.
June	80	101	54	5.5	4.5	9.0
July	82	104	66	6.2	6.1	7.2
August	82	101	64	6.2	3.9	7.6
Summer	81	.....	.....	17.9	14.5	23.8
September	78	98	49	8.1	5.1	19.6
October	71	92	40	5.1	2.7	3.4
November	62	86	26	2.5	0.1	0.5
Fall	70	.....	.....	15.7	7.9	23.5
Year	69	104	10	53.4	38.7	82.1

Average date of last killing frost in spring, February 19, and of first in fall, December 6; date of latest in spring, April 6; and of earliest in fall, November 12.

Normal monthly, seasonal, and annual temperature and precipitation at Eustis, Lake Co., Fla.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	60	84	16	2.2	3.1	1.3
January	58	86	23	3.1	3.3	5.2
February	61	88	16	3.7	1.0	9.6
Winter	60	.....	.....	9.0	7.4	16.1
March	67	92	28	2.9	1.2	1.2
April	70	93	40	2.0	1.7	4.2
May	77	100	51	3.1	2.3	0.8
Spring	71	.....	.....	8.0	5.2	6.2
June	81	103	61	6.4	5.7	7.2
July	83	104	65	6.9	2.8	13.6
August	83	101	63	6.5	9.0	6.0
Summer	82	.....	.....	19.8	17.5	26.8
September	80	98	52	8.0	8.1	6.2
October	73	95	42	3.2	1.9	3.2
November	66	91	26	1.6	1.7	0.4
Fall	73	.....	.....	12.8	11.7	9.8
Year	72	104	16	40.6	41.8	58.9

Average date of first killing frost in autumn, December 28, and of the last in spring, February 18; date of earliest killing frost in autumn, November 18, and of the latest in spring, February 24.

SOILS.

The upland soils of Glenn County consist of materials that were washed down from the higher Piedmont section of the country to the west and deposited in an ancient sea that completely covered this portion of the Coastal Plain region. These sediments, subjected to the action of waves and tides, were reworked and assorted into various grades of sands and sandy loams and subsequently lifted above tide level to be still further altered by erosion, the growth and decay of vegetation, and chemical change. The uplifted ocean floor has been cut through and more or less dissected by streams. Poor drainage conditions have favored the accumulation of dark-colored vegetable matter in the soils occupying the slight depressions, sufficiently in places to give rise to a deep, rich muck. The subsoils in such places are usually light gray or mottled in color, owing to imperfect aeration. The heavy soils of the drainage-way and old tide-water depressions have been formed by the deposition of silt and clay carried in suspension by the waters of local streams and by inland tides mingled with the muddied waters from interior streams. In places there is encountered clayey soil which represents the finer sediments laid down in deep or quiet marine waters, as in case of the subsoil of the Coxville fine sandy loam.

The soils of the river bottoms are strictly alluvial in origin, having been formed by deposition of silt, clay, and sand from stream water bearing soil material derived principally from the red lands of the Piedmont. These lands represent the most recently formed soils of the county; in fact, they are still in course of formation, being added to by each successive overflow.

The poorly drained dark-gray to black lands of high organic matter content are called "Portsmouth soils" (named for Portsmouth, Va., where these soils were first mapped); the well-drained gray to nearly white deep sandy lands of low humus content are classed as Amelia; the gray to dark-gray types underlain by plastic clay of mottled yellow and red color belong to the Coxville series; and the river-bottom lands belong to the Congaree series.

The various types of these series are described in detail and their crop adaptations taken up in the following pages.

PORTSMOUTH LOAM.

The Portsmouth loam consists of a black, mucky, light loam, underlain usually at from 12 to 20 inches by a somewhat lighter colored stiff, plastic clay, slightly mottled in the upper part and very much mottled with ocherous yellow at a depth of about 3 feet. In spots the clay comes near enough the surface to be reached by a

moderately deep plowing. The water table is usually reached at from 30 to 36 inches.

This type occurs in the slight depressions or flat areas where moisture conditions have favored the accumulation of the remains from a luxuriant growth of water-loving trees, shrubbery, and weeds. On account of imperfect soil aeration oxidation has been slow in such situations, consequently the organic matter content is high. Areas ranging from one-half acre to several acres in extent were seen in a number of places 5 or 6 miles west of Brunswick.

The Portsmouth loam is very fertile, and when drained can be easily made a valuable, productive soil. Very good drainage can be effected at a comparatively low cost by means of open ditches, but tiling is to be preferred where the land is intended for intensive cultivation, as in case of vegetable production. The lowest level of the type is not often more than 5 or 6 feet below the level of the surrounding land, and usually natural drainage outlets can be reached in short distances.

A main open ditch or tile through the center or lowest part, with laterals placed at intervals of from 25 to 50 feet, according to local peculiarities of topography and the relation of subsoil to water movement, will be sufficient in most instances to bring about thorough drainage.

This type of soil is especially adapted to cabbage, celery, onions, tomatoes, and strawberries of the truck crops, and to corn, oats, cowpeas, and velvet beans of the general farm crops. Irish potatoes would likely do quite well, but should be preceded by several other crops following an application of lime, as the crop seems to prefer a neutral or acid soil. Both this crop and tomatoes do well on new land, leaving it in good condition for celery and lettuce. For the two last-mentioned crops the depth to clay should be at least 6 inches. Phosphoric acid is generally of profitable use in hastening crops to maturity. Fertilizers for this type should contain less nitrogen and relatively more phosphoric acid and potash than those used on the lighter colored, better drained sandy soils. Lighter applications also are necessary. For celery and cabbage 1,000 to 1,500 pounds per acre of a brand analyzing about 10 per cent phosphoric acid, 3 per cent nitrogen, and 7 per cent potash have been used on land of this character with excellent results. Corn, oats, or forage, following a crop treated as above, would hardly need fertilization. Irish potatoes also would need only a light application of a potash-phosphoric mixture—say, 200 to 300 pounds per acre.

An acreage application of 1 ton to 1½ tons of lime will correct possible sourness and otherwise benefit the soil. The lime should be applied broadcast over the surface at least three weeks before

planting. Ground limestone may be used in larger amounts. This form of lime is less soluble and, owing to its slower action, it is advisable to make an initial application of lime. If desired, ground limestone can be used at the same time for later effect.

The following table gives the results of mechanical analyses of a sample of the soil and subsoil of the Portsmouth loam:

Mechanical analyses of Portsmouth loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21527	Soil	0.0	0.4	0.6	27.5	30.5	22.4	18.4
21528	Subsoil	.0	.2	.6	24.8	26.4	15.5	32.5

PORTSMOUTH FINE SAND.

The Portsmouth fine sand was encountered in areas ranging from small patches to bodies of 10 or more acres in extent in several directions from Brunswick. It occurs principally in flat areas having rather poor drainage—a condition due to the slight depression of its surface below the level of the surrounding country.

The type is somewhat variable in texture, but generally consists of dark-gray to black fine sand, underlain at 15 to 24 inches by white to slightly mottled grayish and yellowish sand. A dense stratum or hardpan of compact brown to reddish-brown fine sand more or less cemented with iron oxides is encountered somewhere between the immediate surface and a depth of 3 feet. This stratum varies from an inch or two to 6 inches or more in thickness. Where it occurs near the surface the soil is referred to locally as "red land." Areas in which this brownish material can be turned to the surface by plowing are considered unproductive. Applications of lime following the turning under of a green crop, as cowpeas or rye, with subsequent frequent stirring of the soil, would probably in a year or two correct any condition unfavorable to plant growth arising from turning up such material. Where a hardpan stratum several inches or more thick and not too feebly cemented lies at a depth of 12 to about 24 inches subirrigation is generally considered practicable, the compact layer holding up the water and insuring proper lateral and upward distribution.

In many of the areas of the type forming shallow depressions, the water table is encountered within 18 to 30 inches of the surface. Subirrigation here also would likely prove successful, as percolation would be limited to the upper level of the underground water, which could be raised sufficiently by subirrigation to bring the water at least within capillary reach of plant roots.

Cabbage palmetto is frequently seen on this soil. Pine and saw palmetto are also common.

On account of its moist nature and adaptability to subirrigation, much of the Portsmouth fine sand is well suited to the production of celery. Lettuce, Irish potatoes, sweet potatoes, cabbage, turnips, onions, strawberries, corn, sugar cane, peanuts, and forage crops can also be successfully grown. The soil should be limed at the rate of about 1,500 to 2,000 pounds per acre. After a year or two of cultivation green or partly matured vegetation, for instance, cowpeas, should be plowed under to supply humus. Heavier applications of a fertilizer somewhat higher in nitrogen and lower in phosphoric acid and potash than recommended for the Portsmouth loam seem to give best results on this soil. An acreage application of 1 ton to 1½ tons of an 8–5–6 brand, in conjunction with 4 or 5 tons of barnyard manure, has been quite profitably used for celery and lettuce. Cabbage and onions would probably need more barnyard manure and less fertilizer. Corn, unless heavily fertilized, can not be expected to do as well as on the loam type. Crab grass grows luxuriantly and should be looked on as an important hay crop or source of green manure, especially following vegetables.

Tile drains for subirrigation should be placed about 25 feet apart. In those areas without a water table or well-developed hardpan above 36 inches, subirrigation, owing to downward instead of lateral and upward movement of water, would probably not be sufficiently effective to warrant its practice. Much of this latter phase, however, lies well for surface irrigation. The type is in need of drainage, such as can be secured either by ditches or by tiling. Tiles serve the dual purpose of removing excess water and of supplying means of subirrigation.

This soil was sampled in three sections—soil, subsoil, and lower subsoil, analyses of each of which were made. The results are given in the table following:

Mechanical analyses of Portsmouth fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21529	Soil	0.0	1.7	4.1	68.1	16.9	6.3	2.8
21530	Subsoil	.0	1.2	3.7	69.8	19.6	4.2	1.4
21531	Lower subsoil	.0	1.2	3.3	63.4	19.2	7.7	5.1

PORTSMOUTH CLAY.

The Portsmouth clay consists of a black sandy clay, underlain at 3 to 5 inches by a very stiff, tenacious, sticky black clay which extends

to a depth of at least 3 feet. At various depths in the subsoil there is sometimes a change of color to yellowish or greenish yellow.

As the line of contact with contiguous sandy land is approached there is a gradual increase in depth of the lighter surface mantle, until the type grades first into sandy loam and finally into sand.

The Portsmouth clay was encountered 5 or 6 miles northwest of Brunswick. It occurs in stream, old drainage-way or sea-arm depressions usually as comparatively narrow strips. Marl was found underlying an area of this soil at a depth ranging from about 15 to 24 inches. It is possible that this calcareous material may have influenced in some way the character of the type. The Portsmouth clay owes its origin to deposition of fine material from overflow water or from water that covered the depressions when lying at relatively lower levels with respect to tide water.

By turning under vegetation and coarse barnyard manure, the structure of the soil can be improved markedly and cultivation thereby made much more feasible. Lime also could be used to advantage as a means of securing a greater degree of friability.

Excellent crops of corn, forage, and probably oats and short staple cotton, can be secured from this land without the use of fertilizer, except possibly moderate applications of phosphoric acid as a stimulant to crop maturity. Vegetables like okra and onions would do well. An initial application of 1½ to 2 tons of burnt lime or 3 tons of ground lime rock would increase the productiveness of this land.

A mechanical analysis of a sample of this soil was made, showing the following results:

Mechanical analysis of Portsmouth clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21534	Soil	0.0	0.4	0.7	25.3	12.9	26.6	34.0

PORTSMOUTH MUCKY LOAM.

The Portsmouth mucky loam consists of a jet-black, very mucky sandy loam to loam, underlain at about 20 inches by a compact, rather plastic black clay, with a high organic matter content. The type was seen in stream depressions in that part of the county where the Portsmouth clay was examined. It is very similar to the latter type in manner of origin, but has been made very much more loamy, owing to a greater accumulation of decaying vegetable matter. The growth of wild grass is very rank.

The type needs heavy applications of lime and better underdrainage. Onions, cabbage, corn, oats, crab grass, and forage crops would do well without heavy fertilization.

The results of mechanical analyses of the soil and subsoil follow:

Mechanical analyses of Portsmouth mucky loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21532	Soil	0.2	1.0	1.8	34.7	12.7	21.1	28.3
21533	Subsoil	.0	1.0	2.0	38.9	12.2	17.9	27.9

COXVILLE FINE SANDY LOAM.

The soil of the Coxville fine sandy loam consists of 4 or 5 inches of grayish fine sand, overlying a light-gray fine sand that grades into mottled gray and yellow sticky fine sand. At a depth varying from about 15 to 24 inches the subsoil is encountered. This is a stiff plastic fine sandy clay, mottled yellow, gray, brick-red, and sometimes yellowish-green in color.

Small pockets or thin layers of fine sand may be encountered at various depths in the subsoil. Also a brownish hardpan layer may be found anywhere from near the surface down to the subsoil.

The type occupies the slight slopes and higher land contiguous to areas of the Portsmouth soils. A lower lying, poorly drained, grayish to drab colored heavier phase was seen in several places.

This soil was found best developed west of Brunswick in the vicinity of Avoca Villa. It is a fine trucking soil, being particularly adapted to tomatoes, English peas, cabbage, cauliflower, lettuce, radishes, asparagus, Irish potatoes, and sweet potatoes.

Subirrigation can be successfully practiced, especially where the hardpan layer is not nearer the surface than 15 inches, and therefore the type is admirably adapted to the production of celery. Tiling for subirrigation should be laid at a depth of 15 to 18 inches.

An acreage application of from 2 to 3 tons of a fertilizer analyzing 6 per cent phosphoric acid, 5 per cent nitrogen, and 7 per cent potash, in conjunction with 10 to 20 tons of barnyard manure, would probably prove efficacious for celery and lettuce. A ton of a 6–5–5 brand, with a heavy application of barnyard manure, would be sufficient for cabbage, onions, cauliflower, and asparagus, while a still lighter application of the same brand would suffice for Irish potatoes, peas, radishes, and tomatoes. Sweet potatoes would not need very much strong barnyard manure. Cowpeas and velvet beans do well and should be grown in rotation with other crops as a means of sup-

plying organic matter and otherwise improving the soil. Good crops of cowpeas and crab grass hay and excellent grazing from velvet beans can be secured. Corn, sugar cane, peanuts, and strawberries would also do quite well after vegetable or legume crops.

The lower lying, light-colored loamy phase mentioned above is a rather unproductive soil in its present condition. It would require thorough drainage, liming, deep plowing, and the incorporation of large amounts of vegetable matter—green crops, turned under, or manure—in order to be put in good condition for crops. Forage crops, grass, and corn would do best in this phase.

The texture of the soil and subsoil of this type is shown by the results of mechanical analyses given in the following table:

Mechanical analyses of Coxville fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21525	Soil	0.1	0.3	0.5	32.2	55.5	7.2	4.4
21526	Subsoil	.0	.0	.2	24.0	35.7	8.2	31.9

AMELIA FINE SAND.

Of the upland soils the Amelia fine sand is by far the most extensive type. It represents the wide stretches of piny-woods land. Frequently the pine, as well as the undergrowth of palmetto, are of a somewhat scrubby growth. Hickory is found here and there over comparatively small areas. Such areas are locally styled "hickory hammock," and are considered more productive than the average of the type, being especially adapted to the pecan and the Scuppernong grape.

The Amelia fine sand consists of light-gray to almost white loose, incoherent fine sand, averaging many feet in depth. A brownish feebly cemented hardpan of variable thickness may be encountered anywhere from the surface to a depth of 3 feet, but in the average of the type this stratum is wanting. Under the greater part of this soil the water table lies at depths below 3 feet, although it is often encountered at 20 to 30 inches in areas near water, where the elevation above tide level is not so great.

Owing to the loose, open character of the soil, rain water rapidly percolates below the reach of plants, and under ordinary seasonal conditions crops suffer for lack of moisture. Very little of the type is under cultivation. The only practical method of handling this soil without irrigation, is to turn under green crops, such as cowpeas and velvet beans, and to make heavy applications of barnyard

manure so as to build up a deep loamlike surface soil capable of retaining sufficient moisture to carry the early maturing crops through dry spells. With sufficient moisture and very liberal use of high-grade fertilizers and barnyard manure a great number of vegetables could be grown. The degree of uncertainty, arising from the attendant danger of droughts, necessarily lowers the value of the type, and there are some who look upon such land as practically unsuited to agriculture. There is no question that land with a clay subsoil or even that with a hardpan or water table within 18 to 30 inches is much surer of profitable returns, but it is not at all impossible to handle the type in a profitable way. Even without irrigation early sweet potatoes, Irish potatoes, lettuce, and a number of other vegetables can be produced with fair success if planted upon land enriched by turning under green crops or by applying barnyard refuse. With surface irrigation, where the water is supplied by a system of spraying or other means insuring thorough distribution, there would be no difficulty in securing good yields of a great variety of vegetables.

The keynote to success with this soil is surface irrigation and heavy fertilization including the frequent turning under of green vegetable matter. Those areas having a hardpan subsoil or water table near enough the surface to insure the success of subirrigation, and such areas are found in a number of places, can be profitably used for celery, lettuce, and other vegetables.

An analysis of the soil gives the following results:

Mechanical analysis of Amelia fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21521	Soil	0.2	0.9	2.9	60.7	23.7	6.8	4.8

CONGAREE CLAY.

The Congaree clay is the predominant soil of the river bottoms. Several thousand acres are included in the rice plantations of the Altamaha River.

The type consists of a reddish-brown to dull chocolate-red clay, slightly friable at the surface and mottled with drab and dark brown below the first 6 or 8 inches. The depth is usually considerably over 3 feet, the lower portion being decidedly plastic. The level of the water table is usually about 14 to 24 inches below the surface. Lying below the level of high tides and flood water, diking is necessary for the reclamation of the type. Utilization of these flat river flood plains was begun over one hundred years ago, when levees were built along the

water front and ditches dug for drainage and the distribution of irrigation water. Canals have been carried through the plantations, cutting them into small fields or sections of convenient size for irrigation, and ditches cut through the fields to insure proper distribution and drainage.

At first sugar cane, cotton, rice, peas, and corn were grown, but rice proved so profitable from the beginning that it was soon grown to the practical exclusion of the others. The soil is admirably adapted to this crop; and notwithstanding the strong competition that has arisen from the recent extensive development of the rice industry in Louisiana, Arkansas, and Texas, its production here has been maintained upon a profitable basis, a fact partly accounted for in the excellent quality of the product. That a large cleaning mill has just been completed at Sterling is an indication of local confidence in the future of this industry in Glynn County. Some complaint of decreased yields is heard, which is not in the least surprising when it is considered that the land has been cultivated to the same crop almost continuously for a century and rarely or never plowed deeper than 3 or 4 inches. Some land is "rested" during alternate years, but it is believed that rotation with cowpeas, velvet beans, or other crops, coupled with deeper plowing and an application of 1 to 2 tons of lime or 3 tons of ground limestone per acre, would prove a much more profitable plan. With frequent additions of silt and clay sediments from irrigation water it is difficult to conceive of a more fertile soil than this deep alluvium, representing largely material transported from the productive Piedmont section. Its productivity can but depend upon careful soil treatment, and acreage yields of less than 50 bushels of rice should be of rare occurrence. There are no insect pests attacking the rice, but considerable grain is lost through the depredations of rice birds, unless these are scared off by gunners.

Occasionally serious damage is done by flood water breaking over the dikes during storms. Careful and timely repair of weak places in the dikes will reduce danger from this source to a minimum of negligible importance. A great disadvantage rests in the necessity of hand harvesting. No practical machine for operation under the soggy, miry conditions existing at harvesting time subsequent to the withdrawal of the "harvest flow" has been perfected.

Several varieties of rice are grown, the Carolina, Honduras, Japanese, and Golden being the important ones. The usual method of handling this crop in the Carolina-Georgia rice belt is to break the land to a depth of 3 or 4 inches and harrow. The seed, planted in drills about 14 inches apart, is lightly covered and water turned on after a brief interval. In a few days this "sprout flow" is drawn off and the ground allowed to stand dry until the grain is well up, when a

second application of water or "stretch flow" is made. During this flooding the water remains on the field for fifteen to thirty days, destroying grass and hastening crop growth. The "dry growth," or period of cultivation, follows the removal of this water. The crop is usually cultivated once with the horse hoe and from two to three times with the hand hoe. When the plant begins to joint, water is again turned on and gradually increased in depth until the heads are nearly reached, where it is kept until the grain is ripe. The "harvest flow" is now removed and the crop cut with the hand hook, or sickle.

In addition to its admirable adaptation to rice, the Congaree clay has proved to be well suited to Bermuda onions, cabbage, Irish potatoes, snap beans, cowpeas, lettuce, and certain varieties of tomatoes. The Clay, Unknown, and Whippoorwill varieties of cowpeas give best results. Heavy yields of cabbage, beans, and Bermuda onions have been made, and there seems on this type very attractive opportunities for a considerable extension in the production of these crops. A field of cotton seen at the time of this investigation, though badly affected by anthracnose, indicated a yield of one-half bale per acre. Varieties of cotton bred upon a sandy upland could scarcely be expected to succeed here, but it is believed that successful bottom-land types could be evolved.

Lime should be used liberally and crop rotation practiced in order to secure and maintain good soil conditions. Applications of phosphoric acid would tend to hasten maturity and otherwise prove beneficial on this soil.

"Fire weed," or "careless weed," is said to cause considerable trouble in cotton fields, on account of the difficulty of its eradication by other means than flooding.

The heavy character of this soil is shown in the following table giving the results of a mechanical analysis:

Mechanical analysis of Congaree clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21522.....	Soil.....	0.0	0.4	0.4	1.7	0.6	41.0	56.1

CONGAREE MUCKY SANDY LOAM.

The Congaree mucky sandy loam consists of 6 to 8 inches of almost black heavy sandy loam, rich in organic matter, overlying a light-gray compact sand that usually passes into mottled clay at a depth of about 2 feet, though it sometimes extends to a depth of 3 feet or more. This soil is known locally as "bay land."

It is well suited to rice, sugar cane, cabbage, celery, okra, Irish potatoes, sweet potatoes, lettuce, onions, tomatoes, and possibly other vegetables. The Wilcox, a large variety of sweet potato, is grown to a considerable extent for canning. Yields of 210 bushels of Irish potatoes per acre are reported. Corn, cowpeas, and velvet beans would do well.

This soil should be used more extensively for the production of vegetables. Strips of considerable extent were seen in the rice fields of Hofwyl, Evelyn, and Altama plantations.

PEAT.

Several strips of Peat occur near the foot of the bluff bordering the Altamaha River bottoms. It consists of black mucky material, underlain at a depth of a few inches by brownish peaty vegetable matter. On boring into this material, as in case of the other rice lands, decayed cypress logs were encountered.

This is an ideal celery soil, and is well adapted to onions, cabbage, peppers, okra, squash, and tomatoes. Rice also does well. Situated so that drainage and irrigation can be effected at will, excellent opportunities are here offered for growing the crops named.

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