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U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

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

SOIL SURVEY OF THE OCALA AREA,
FLORIDA.

BY

CHARLES N. MOONEY AND W. J. LATIMER, OF THE U. S.
DEPARTMENT OF AGRICULTURE, AND HERMANN GUNTER
AND EMIL GUNTER, OF THE FLORIDA STATE
GEOLOGICAL SURVEY.

HUGH H. BENNETT, INSPECTOR IN CHARGE SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1912.]



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., March 15, 1913.

SIR: The accompanying report and soil map cover the survey of the Ocala area, Florida, one of the projects undertaken by the bureau during the field season of 1912. This work was carried on in co-operation with the Florida State Geological Survey, and the selection of this area was made after conference with the State officials, and bore the indorsement of Hon. S. M. Sparkman, within whose district the survey lies.

I recommend that the report and map covering this work be published as advance sheets of Field Operations of the Bureau of Soils for 1912, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

Soil map, Ocala sheet, Florida.

SOIL SURVEY OF THE OCALA AREA, FLORIDA.

By CHARLES N. MOONEY and W. J. LATIMER, of the U. S. Department of Agriculture, and HERMANN GUNTER and EMIL GUNTER, of the Florida State Geological Survey.

DESCRIPTION OF THE AREA.

The Ocala area is situated in the north-central part of the Florida Peninsula, approximately midway between Jacksonville and Tampa. From the Gulf of Mexico the western boundary is distant about 15 miles, while the eastern boundary is approximately 60 miles from the Atlantic coast. The area is rectangular in shape, about 35 miles long north and south and 30 miles wide east and west.

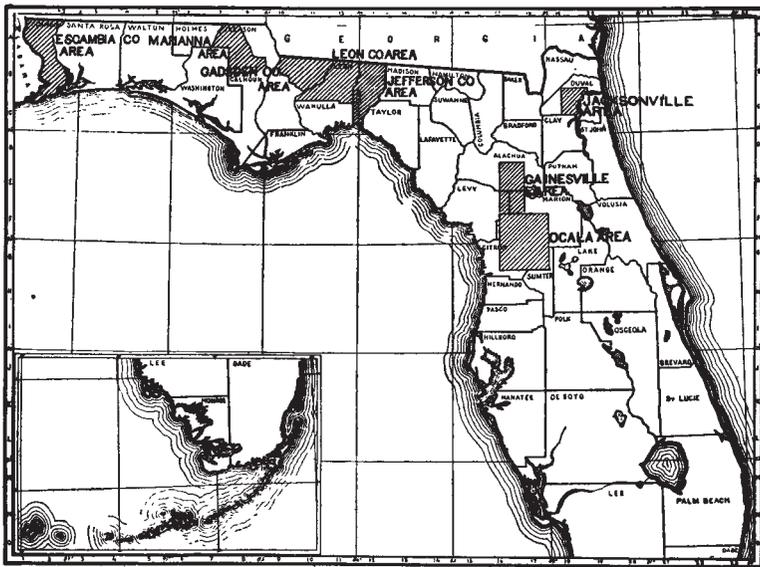


FIG. 1—Sketch map showing areas surveyed in Florida.

Topographic sheets were made of this section some years ago by the United States Geological Survey. These were used as the base for mapping the soils, such changes as were necessary to bring the road systems in accord with existing conditions being made.

The survey comprises an area, inclusive of the bodies of water, of about 1,002 square miles, or 641,280 acres. It covers parts of Marion, Sumter, Citrus, and Levy Counties, about half the area mapped being in Marion County.

The peninsula of Florida lies in the physiographic province known as the Coastal Plain. Roughly, the peninsula consists on either coast of a generally flat coastal country, only slightly elevated above sea level, with an elevated region extending down through the center, the elevation attained being 200 or more feet on the highest points. This elevated region is spoken of as the backbone of the peninsula and has been held up by the underlying rock beds. The Ocala area is situated in this elevated region and has a varied topography ranging from flat areas, known as "flatwoods," to rolling areas and high "hammocks." The general elevation ranges from 40 feet above sea level in some of the stream valleys to 220 feet in the western part of the area.

This part of Florida is underlain by limestone at no great depth; in fact, in places it outcrops at the surface. In the geologic past the region, while elevated, was subjected to erosion, resulting in an irregular surface. In addition, the limestone, being more or less soluble, was dissolved in places, forming subterranean caverns, which in falling in gave rise to sinks and large basins, further modifying the surface. Then, with a period of submergence, there was a deposition of sedimentary materials (mostly marine) over this irregular surface, and their emergence followed in time, attended, no doubt, by minor changes in the surface by erosion. The sinks and basins remained and as the solution of the limestone has continued these have enlarged to form ponds and lakes, and even new sinks are forming at the present time.

In detail the Ocala area consists largely of rolling and low, hilly country, intersected by the Withlacoochee River, with its low, flat areas and swamps, and by Tsala Apopka Lake. Coming in at the north-central boundary of the area is a body of high hammock land belonging to the "middle hammock belt" described in the State geological reports. It consists of irregular bodies of low hills, ranging from 90 to 180 feet above sea level, the tops of which are rounded to flat, with some depressed basins and rather smooth, long slopes having numerous eroded draws or ravines occupied by small streams which empty into sinks on the bottom of the slopes.

These areas of hammock land are not continuous, occurring as scattered islandlike bodies in the rolling sand areas of the country. They occur in the area in Marion and Sumter Counties, the largest being around Ocala, and are upheld by underlying rock formations. The greater part of the area is occupied by what is known as the "rolling pine lands." These lands comprise country of irregularly distributed elevations and depressions, largely the result of the great number of sink depressions caused by the solution of the underlying limestone. The result is a choppy topography, which here and

there flattens out to gently undulating. A gently undulating belt follows that of the high hammocks, the change in elevation being only 10 to 20 feet and averaging about 80 feet above the sea level. To the west the rolling sandy lands become much more choppy and higher, and east and north of the Withlacoochee River attain elevations of 120 feet on the higher points, with some on the western border north of Dunnellon reaching 150 feet above sea level. South and west of the Withlacoochee the surface is very broken, being marked by large and deep depressions, the bottoms of which lie from 10 to 40 feet above sea level, while the summits of the surrounding hills attain a height of 150 to 220 feet above sea level.

Cutting through this rolling country is a broad belt of low, flat country extending from a few miles east of Dunnellon southeast out of the area. The Withlacoochee River flows through it and it may be termed the valley of this river. Associated with it is Lake Panasoffkee on the east and Lake Tsala Apopka on the west. This is a section of low-lying flatwoods, interspersed with prairie ponds, low hammocks of semiswampy character, and cypress swamps. The average elevation of this section is between 40 and 50 feet above sea level, with a few higher elevations. In appearance and condition Lake Tsala Apopka resembles the Everglades. It consists mostly of shallow water, with a thick growth of saw grass, interspersed with open, deeper bodies of water and with areas of land having a characteristic growth of scrub saw palmetto and stunted pines and lying but slightly above the elevation of the lake. There are some land areas supporting a "hammock" growth, and also cypress "bays" here and there. In the latter the tallest cypress trees are in the center, the trees gradually decreasing in size toward the edge in such a way that they stand out on the sky line in triangular or pyramidal form with the apex near the center. There are also some sandy islands that rise as high as 20 feet above the water. The descent into all this low-lying region from the adjacent rolling lands is rather abrupt.

In the northeast section of the area there is another low-lying strip of hammock flatwoods and swamp following Silver Springs Run, which is a part of the Ocklawaha River Valley, lying just outside of the area. Again, just west of Dunnellon a flatwoods area begins and extends west out of the area. This is evidently a part of the low coastal country reaching to the Gulf.

Aside from the large streams there are strikingly few streams in the area. The exceptions are the small branches following down the draws on the slopes of the high "clay hammocks." These flow intermittently as a rule and soon disappear into sinkhole ponds. The water falling upon the surface either seeps into the sinks and swamps

or percolates downward through the porous sand into the underlying porous limestone, finally reaching subterranean channels. Some of these subterranean streams come to the surface, as strikingly illustrated by Silver Springs in the eastern part of the area and Blue Spring in the western part. These "springs" discharge a large quantity of water, the seasonal variations of the volume being very little. There are also a number of smaller springs in the low hammocks and swamps.

A part of the drainage waters reaches the Atlantic Ocean by way of the Oklawaha and St. Johns Rivers. Silver Springs Run is the main source of supply of the former. The run and the river are both navigable streams, and are used for passenger and freight boats. The Withlacoochee River is of considerable size, rising some distance to the south of the area. It flows in a northwest direction through the area. A part of it is navigable.

Settlement within the area surveyed followed some years after that of Alachua County, in which settlement was begun in 1825. The early settlers came originally from the Carolinas and Georgia, and immigration from these States has continued even to the present time. In the last few years there has been some immigration of people from the Northern, Western, and Southern States, attracted by the mild climate and the agricultural possibilities of this as well as of all other sections of the State. The present population is thus an aggregation of the native stock of the State and of the different States of the Union. There is also a large negro population scattered throughout the counties represented in the survey. Marion County is one of the largest in the State and has a population of 26,941, according to the Thirteenth Census. Levy, another large county in areal extent, has 10,361 inhabitants, and Sumter and Citrus, much smaller counties, have, respectively, 6,696 and 6,731.

Ocala, the county seat of Marion County, is the largest place, having a population of 4,370 within its corporate limits in 1910. It is an important railroad center and a prosperous business town, its business interests reaching into the adjoining counties. Its banking business extends to all the industries of the section, including phosphate mining, lumbering, turpentine, and agriculture.

In the western part of the area surveyed, on the Atlantic Coast Line Railroad, are the towns of Dunnellon, Hernando, Holder, and Inverness. They are in the phosphate mining district, and their inhabitants are largely engaged in this industry.

On the Seaboard Air Line Railway, in the eastern part of the area, are the towns of Belleview, Summerfield, Oxford, Wildwood, and Coleman. Their interests are entirely agricultural. In addi-

tion there are a number of smaller places on the different railroad lines that are shipping points for forest and farm products.

The railroad facilities of the area surveyed are exceptionally good. Main lines of the Seaboard Air Line and Atlantic Coast Line traverse the area from north to south, with some smaller branch lines of each road. These give good transportation facilities for both passengers and freight to both North and South. In addition, there are two new roads, the Ocala Northern, extending from Ocala to Palatka, giving a short route to the east coast, and the Ocala & Southwestern, reaching into the central part of the area from Ocala and Martel. There are also some logging railroads that are expected to be made permanent.

The county roads are fast being improved to meet the present and future needs. A considerable mileage of clay surface or stone roads reaches out of Ocala in every direction. There is also a stone surface road connecting Dunnellon and Inverness. The making of hard roads is being extended, and they are planned to form parts of the important highways of the State.

The general farm products meet with a ready sale in the surrounding towns, and, in fact, there is not enough produced to supply the local demands, so that a large quantity is shipped in. Large quantities of grain and hay are shipped in to feed the working stock. The truck and citrus-fruit crops are shipped to northern markets and lumber and turpentine are sent to outside markets for these products. Most of the phosphate rock mined in the area is exported to foreign countries.

CLIMATE.

No extended climatological records have been kept within this area. Observations for short periods have been made at Ocala, Rockwell, and Inverness, but not long enough to obtain normals. The longest records available are those for Archer, which lies some distance away in the adjoining county to the north. The data given in the following tables have been taken from the Weather Bureau records for that station. The tables give the normal monthly, seasonal, and annual temperature and precipitation. These figures vary but little from those for the stations within the area for the short period the latter have been taken, and so may be taken as fairly representative of local conditions.

Normal monthly, seasonal, and annual temperature and precipitation at Archer and Ocala.

Month.	Archer.						Ocala.	
	Temperature.			Precipitation.			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.	° F.	Inches.	
December.....	57	89	13	3.3	1.6	5.6	58.0	2.37
January.....	55	84	17	3.2	5.0	8.2	57.4	2.73
February.....	59	90	10	3.9	3.8	6.9	59.6	3.19
Winter.....	57			10.4	10.4	20.7	58.3	8.29
March.....	63	94	24	4.1	0.8	3.8	65.3	2.89
April.....	68	94	33	2.7	2.0	0.3	69.4	2.01
May.....	75	101	46	3.9	0.8	6.6	75.5	3.38
Spring.....	69			10.7	3.6	10.7	70.1	8.28
June.....	80	101	55	7.1	7.2	11.4	79.7	7.69
July.....	81	101	59	8.4	6.4	5.9	81.4	8.19
August.....	82	99	59	7.3	7.8	10.2	81.2	7.54
Summer.....	81			22.8	21.4	27.5	80.8	23.42
September.....	79	98	48	6.1	3.6	11.6	78.7	7.35
October.....	71	94	32	2.6	2.0	4.8	72.0	2.69
November.....	63	88	20	2.3	0.6	1.4	64.2	1.61
Fall.....	71			11.0	6.2	17.8	71.6	11.65
Year.....	69	101	10	54.9	41.6	76.7	70.2	51.64

The climate is mild and agreeable, the mean annual temperature being 69° F. It approaches that of the subtropics. The summers are not regarded as excessively hot, as they are tempered by practically constant winds. The only discomfort is that brought on by long-continued uniform heat. The temperatures occasionally hover around the hundred mark and maximum temperatures of 101° F. have been recorded in May, June, and July. The normal seasonal summer temperature is 81° F. The spring and fall seasonal means vary little from each other, the former being 69° and the latter 71°.

The winters are mild and generally pleasant, there being occasional cool spells of a few days when the temperature goes slightly below the freezing point. Lower temperatures have occurred, but are infrequent; a minimum of 10° F. above zero at Archer has been recorded. The possibility of such extremes makes the growing of citrus fruits risky, but the danger is now being met by the use of oil smudge pots or open fires in the groves.

The mean annual precipitation at Archer, as shown by the table, is 54.9 inches. At Ocala the mean for 16 years is 51.64 inches. At Rockwell for a period of nine years it is 52.55 inches, and at Inverness 51.74 inches. This rainfall is not evenly distributed, the greater part falling during the summer months. A wet and a dry season are recognized, the summer being the wet season, while the winter is looked upon as the dry season. There are really two periods of each. The wettest season extends through June, July, August, and a part of September. This is followed by a comparatively dry season, beginning the latter part of September and extending through October, November, and December. There is then a short season of good rainfall in January and February, followed by the driest part of the year in March, April, and May. The summer rains are torrential and of tropical character, occurring mostly in the afternoon and rarely at night, the clouds usually disappearing by sunset. As shown by the table, there is considerable range in precipitation from year to year, there being a difference of 35 inches between the wettest and driest years. Since the so-called dry season occurs in winter and spring, when the rainfall is moderate and irregular and periods of drought are frequent, trucking is often seriously affected, so that irrigation is essential for the greatest measure of success. Some irrigation is practiced, the overhead system being used. (See Pl. I, fig. 1.) As the elevation is too high for artesian flow, the water must be pumped.

On an average there is no danger from frost for about 9 months of the year, but the growing season is very often extended beyond this. Winters occur when there is comparatively little frost and this restricted to a short period. January and February are the months during which frosts are to be expected.

Cabbage is the only trucking crop grown during the winter. Most of the other truck crops are planted in February. In the case of tomatoes the seed are dropped in the row and thinned for stand. In a couple of weeks seed are dropped in between, so that if frost occurs the second planting will come on, and often even a third planting is made in order to insure a crop.

As the area lies inland, the winters are somewhat colder than along the coast and the summers warmer. This difference amounts at times to several degrees. The citrus groves are located as near the bodies of water as possible, experience having shown the modifying influence of even small water areas where the minimum temperature lies normally so near the limit of safety.

While the bodies of water are not such as to make the region attractive as winter resorts, increasing numbers of winter tourists are coming to the region, the eastern boundary of the area touching what is known as the lake region of the State.

AGRICULTURE.

The extension of settlement within the area surveyed took place slowly, and its population was until recently confined to a few communities. The early agricultural operations were not extensive and farming was mainly of a self-sustaining type, markets being remote. Corn, rice, sweet potatoes, and sugar cane were grown for home consumption. Soon, however, the growing of sea-island cotton was begun. This could be marketed by water and was the main source of income. Though the growing of sea-island cotton assumed considerable importance in central Florida, it only reached into a small part of this area on the hammock lands in the central part of Marion County. After a time, it is reported, the "caterpillar" became a great pest, and the growing of cotton was partly abandoned, but in recent years, owing to the lack of labor for more intensive farming, the growing of this staple has been extended. Particularly profitable was the crop following the Civil War, when cotton prices were very high.

Stock raising was also taken up in the early days. Practically all the country was an open range, and stock could graze over large areas. The prairie "ponds" afforded good pasturage at certain seasons, and there was also pasturage on the higher lands. In the swamps and low hammocks there was good grazing for cattle and plenty of mast for the hogs, so that both thrived. Cattle raising finally attained much importance, becoming the sole occupation of many, and it has remained a leading industry to the present time. The cattle, however, were not of the best, as they received no care, and during the winter season many starved for lack of sufficient food. Even with the great losses entailed, good profits were obtained, because of the fine range, the stock raisers being under no expense beyond looking after and marketing their stock.

In 1859 an orange grove was started at Micanopy, in the county north of Marion, by budding the sweet orange on the sour wild-orange stock. This venture proved successful and the growing of citrus fruits soon extended, as the fruit met with a ready demand. The soil and climate were suited to the growing of citrus fruits and the industry rapidly developed, suitable lands being in great demand and bringing good prices. In the late eighties the lands were greatly exploited for citrus fruit growing and a land boom was started, values rising rapidly. Even the high sandy lands, considered of little value, were put on the market and brought high prices. Then, in 1888, hard phosphate rock was discovered and exaggerated views were held as to its extent and value. This, together with the exploiting of land for citrus fruit growing, caused the wildest speculation to ensue. Towns were laid out in this area and lots brought high

prices, but as these lots were bought by people remote from the section and for speculation, the building of the towns did not follow. These abnormal conditions could not last long and the boom necessarily collapsed, the reaction causing a great depression throughout the section, which affected agriculture especially.

Agriculture met with another reverse a few years later, when during the freeze of 1894-95 all the orange trees in this section were killed to the ground. With few exceptions, this practically ended the growing of fruit in the area. Prior to the freeze every home had its orange grove, which yielded a fair income. In fact, dependence was placed mostly on the orange grove and the stock on the range and little effort was put forth to cultivate the land beyond the growing of subsistence crops. After the freeze lands were abandoned and forfeited to the State for nonpayment of taxes. The value of the lands fell to almost nothing. Some of the best hammock lands up to 1900 could be bought for a mere trifle. This freeze caused temporarily the greatest setback that agriculture has had in the section. There have been other freezes, but none that were so widespread or so severe.

Along in the nineties the turpentine industry began and grew rapidly. A small income was derived from this source, as previously the trees had very little value, lumbering not having reached this section. However, the saw mill soon followed and began cutting into the pine forests. The prices paid for the privilege of turpentineing were small as compared with those paid now. Two or three cents a box was formerly a good price, and it has gradually risen, as the working area has decreased, to 15 cents or more a box.

In the county north of the area surveyed trucking, which had been taken up to some extent before the freeze, was greatly extended afterwards and was fostered by the extension of railroads into the region. The trucking industry, however, did not develop in this section, at least not to any marked extent. A notable exception was the beginning of trucking in Sumter County, near what is now Coleman, in the Warm Spring hammock, where the growing of cabbage for market was begun. This was about 1888. This hammock was found especially suited to the growing of this crop, the production of which attained considerable importance, and has continued without interruption to the present time. In this same hammock there was also a large orange grove, which was killed during the freeze of 1894-95.

The area of hammock lands being small, and other soils, as the sandy ones, being held in low esteem, the growth of agriculture was retarded, and even the areas cultivated were not made as productive as they should have been, so that the agricultural resources of this section

have hardly begun to be developed. The interests within the area are varied. The western part, which is in the belt where the hard-rock phosphate is found, is devoted entirely to the mining of phosphate rock, no attention being given to agriculture, partly because of the undesirability of the land for farming purposes. Turpentine is still an important industry and large quantities of turpentine and rosin are produced. The sawmills still have considerable forest to work upon, and there is a great deal of interest in this industry. Cattle and hogs are raised in considerable numbers and still roam at will over the open range, but this is being restricted gradually by owners fencing in their holdings. Stock raising remains profitable because the stockman is still at no expense to get his cattle ready for market. With the growing population, beef and pork find good home markets, the production of pork not being sufficient to fill the demand. Some cattle are shipped out to southern cities. While many of the cattle are of poor grade, owing to the manner in which they are raised, they are suited to the conditions they must endure. Some improvement is being brought about by the introduction of pure-blooded sires of improved breeds, particularly the Jersey and the Hereford, but it is not general. Some herds have been improved greatly. Hogs are receiving considerable attention, and the razor-back is gradually being displaced by better stock.

During the last two or three years the cultivated areas of farms have been greatly increased. The agriculture of the area consists of growing the general farm crops along with heavy trucking, in which a large acreage is usually involved. The general farm crops follow the truck crops, the latter being heavily fertilized, and the following crop, such as corn, getting the benefit of the fertilizer remaining in the soil. Thus, corn always succeeds crops that are marketed early, such as cabbage, tomatoes, and snap beans. Besides corn, the velvet bean is an important field crop. This plant matures its seed in this section and is sold for seed. The light sandy soils of the Norfolk series will grow the velvet bean and improve in productiveness at the same time. The crop is grown alone or with corn. It is said to do better with corn, as where it covers the entire ground the growth is so rank that it smothers itself. Ten bushels or more per acre is considered a good yield, and 15 to 20 bushels are often obtained. Oats are grown to some extent, being cut when in the heading stage and cured for hay. Peanuts are grown extensively, especially on the lighter soils. These are grown between the rows of corn, and while much of the crop is intended for feeding hogs, a considerable proportion is harvested and put on the market. In 1909, according to the Thirteenth Census, there were 5,046 acres in peanuts, yielding 88,958 bushels. The peanut, aside from its value as a certain crop, is desirable as a soil improver.

Sugar cane is grown on every farm, but few produce more than enough to make sirup for domestic use. The product, which is being manufactured by the open-kettle process, is of excellent quality. About 15 to 20 barrels of sirup to the acre can be made. A number of varieties of sugar cane are grown, but the Japanese cane is much in favor and makes a good forage crop, as well as an excellent grade of sirup. Cowpeas are grown quite generally for hay. A source of hay is the crab grass, crowfoot, sandspur, and beggarweed, which appear as volunteer growths following all cultivated crops. They make a fairly good growth and quantities of hay of this class are usually obtained each year by all the farmers.

Sweet potatoes succeed on all the light soils and are grown universally, but in no large acreages, the output being hardly sufficient to supply the local market demands.

Trucking is now assuming a place of considerable importance. Especially has the industry developed during the last few years. The crops are those that come under the class of heavy truck and are grown in large acreages, though recent purchasers of small acreages of land are entering to some extent into trucking. The crops grown are watermelons, cantaloupes, cucumbers, snap beans, cabbage, and tomatoes, with some egg plants, peppers, and beets.

With the exception of watermelons, trucking is confined to the hammocks around Ocala and those along the Seaboard Air Line Railway from Belleview south, Summerfield and Oxford being trucking centers, as well as Coleman, lower down.

Watermelons are grown in large acreages, and, being a heavy crop, they are confined to sections near railroads. The logging roads reaching into the central part of the area in the areas of light sandy soils, the Norfolk sand and the Norfolk fine sand, are fostering the growth of this crop and haul the product out to the main trunk railroads. The light soils are especially adapted to watermelons and a fair return is realized. Land for this crop must be highly fertilized. The yield is about one-half carload to the acre. The trouble encountered in growing watermelons is the wilt disease, because of which the crop can not generally be successfully grown a second time on the same land for a period of several years. Several varieties are grown, those for market including the Kolb Gem, Big Blue, and Tom Watson. The crop is planted in hills, generally 6 by 9 to 9 by 9 feet apart. The crop is fertilized, using from 500 to 1,200 pounds to the acre of a high-grade special brand. Newly cleared sandy pine land is preferred. The Gainesville loamy sand is also used for the crop and gives somewhat higher yields than the lighter sandy soils.

Cantaloupes are grown quite extensively, but on account of diseases the acreage planted to the crop the past season is said to have been reduced. The Rocky Ford is the only variety grown, the seed

being obtained every season from the Rocky Ford district of Colorado. The Gainesville loamy sand and the Gainesville sandy loam are the most desirable soils for this crop, though the better phases of the Norfolk sand at present are also used. The finer textured Gainesville type would also be adapted to their production. About 100 crates is considered a good yield per acre, with an application of 600 to 700 pounds of a fertilizer mixture analyzing about 7-3-4. Experiments are in progress by the Department of Agriculture in this area to demonstrate the methods of fighting the diseases of these and other truck crops.

Cucumbers are grown to some extent. The White Spine is the variety planted. The Gainesville soils are suited to this crop, also the lower-lying, well-drained Portsmouth soils and the better phases of the Leon and Norfolk soils. They receive heavy applications of commercial fertilizers and generally yield some profit to the growers.

Cabbage, as stated previously in this report, was the first truck crop grown and shipped out of the area. The high yield and quality of the cabbage, as well as of tomatoes, grown in the Warm Spring hammock at Coleman have made this section widely known. All the heavier soils, especially those having a calcareous or marly subsoil, are desirable for cabbage. This crop also succeeds well on areas of Gainesville sandy loam, having shallow surface soil. In this area the Parkwood and Fellowship series of soils are best adapted to this crop, and its production is mainly confined to these soils. The crop is transplanted to the fields from the middle of September to January, the early cuttings being made for the Christmas market and later ones in April. It is usually planned to put about 11,000 plants on an acre and an average yield of about 250 crates is expected, but the range is considerable, as high as 440 crates to the acre having been obtained at Coleman. On the lighter soils the yield is somewhat lower, but the quality is good. A crate averages about 110 pounds and the average cabbage about 3 pounds. The crop is heavily fertilized on all soils, even on those that are considered rich, such as the calcareous or marly hammocks. At Coleman from 1,000 to 1,500 pounds per acre of a 5-6-8 fertilizer is generally used, but the relative proportions of the different elements vary in different brands. Some claim that 5 per cent of potash is sufficient on the marly lands, but for tomatoes 8 to 10 per cent of potash is better. Cottonseed meal mixtures are used generally and where any crop needs forcing an application of nitrate of soda is given. A number of varieties of cabbage are grown. The flat heads are more in favor than the pointed heads of the Wakefield type, as it is claimed they make larger yields. Market Garden No. 2 is most favored. It makes a flat, firm head and is a sure header. Henderson's Succession and Allhead Early are also planted. The growers of cabbage



FIG. 1.—ARRANGEMENT OF PIPES IN OVERHEAD SYSTEM FOR IRRIGATING VEGETABLES.



FIG. 2.—NORFOLK SAND, LOAMY PHASE, NEAR OXFORD.

[This soil, where supporting a growth of longleaf pine, such as shown in picture, is locally called "open pine woods." The soil is deep and sandy and requires heavy fertilization to give good yields. This land is adapted to vegetables, velvet beans, melons, and sweet potatoes.]

and tomatoes in the Warm Spring hammock have made profits consistently and are in good financial condition as a whole. The holdings are small; 10 acres is considered enough. Some of the growers have installed overhead irrigation plants. (Pl. I, fig. 1.) While this is expensive, it makes the production of a crop more certain, as the winters are the dry season of the year and water is generally needed. There is plenty of land that could be utilized for this crop.

There is a considerable production of tomatoes in the area. The tomatoes grown at Coleman, in the Warm Spring hammock, find favor on the market. The fruit is heavy and firm and is said to bring fully 50 cents a crate more than the average market price. The Globe variety is grown exclusively, having been found more resistant to diseases than other varieties, as well as making good yields. The Stone tomato used to be grown, but not being as resistant to disease, poor results were often obtained. The same grade of fertilizer is used for tomatoes as for cabbage, about 1,000 pounds per acre being applied, although, as stated before, this crop needs more potash than does cabbage. About 200 to 300 crates to the acre are considered a good yield.

Snap beans are an important crop and are grown in large acreages. They grow well on the Gainesville types of soil, on the better phases of the Norfolk, and on the sandy types of the Fellowship series on the high hammocks.

Some eggplants and peppers are grown, but these are not important crops in the area surveyed.

Before the freeze of 1894-95 the area surveyed was within the citrus-fruit belt of the State. There were groves on every place, and many put their dependence solely upon the products. Along the Withlacoochee River there was considerable interest in orange culture, and there were many large groves. These were all killed and practically all abandoned, the people even moving out. Citrus-fruit growers then moved farther south, but a few large growers have reestablished their groves. Citrus-fruit growing is now confined to some important groves around Lake Panasoffkee and to a low hammock southwest of Wildwood. This hammock is in one grove of over 500 acres, which is one of the largest in the United States. The freeze of February, 1899, did considerable damage. The trees are young and small and have not yet reached their full bearing capacity, but are just beginning to yield some profit. The low hammocks surrounded by swamps are preferred, the swamps and the large trees left standing in the groves being depended upon for protection. The marl hammocks are most desired, and on these fertilizers are not used. On these low situations the trees are planted on mounds, so that they

will be out of the water during wet periods. There is also less trouble from insect pests in these locations, especially where the groves are isolated from other groves. However, insect pests and diseases have to be fought and controlled by spraying. The Pineapple orange is one of the favorite varieties. The King and Harts Tardiff are also important varieties. Some grapefruit and tangerines and a few Satsuma oranges are grown.

Nut culture would probably prove profitable in this area. The pecan will thrive in the climate and soil, and some pecan groves have been started, but have not reached the bearing stage. As far as observed, they are given very little attention.

Crop rotation is not thought of as such, because of the fact that two or three different crops are taken in a season from the same land. The cabbage, for instance, is often grown year after year on the same land, but it is always followed by corn, and after this a crop of crab-grass or beggarweed hay is obtained. Corn follows practically all the trucking crops, receiving benefit from the fertilizers applied to the preceding crop. When a crop is late it is often followed by cow-peas, which are cut for hay. The light, sandy soils, where no trucking is being done, bring only two crops, corn and then crab-grass hay or peanuts and velvet beans, either with or without the corn. A common practice is to let the land lie fallow each alternate year, or rather to let the weeds grow and then plow them under. This benefits the soil, but a better way would be to grow a legume and turn it under.

All engaged in truck growing necessarily follow modern methods and use improved farm implements. There are still in use by some the little 1-horse turning plow and the old type of small, straight plow and sweep rather than the several-toothed cultivators that do so much better work. On newly cleared land, however, these old implements are often all that can be used. With the exception of the heavy hammocks, the soils are all easily cultivated and kept in good tilth.

Fertilizers are applied generally, though where general farming is practiced alone little or none is used. The yields of corn and oats are small. On the truck crops large quantities of high-grade fertilizers are used. Special brands carrying varying proportions of the different ingredients required for particular crops are made by the fertilizer companies represented in this section. These are the cottonseed meal mixtures, and contain some dried blood and tankage as a part of the nitrogen supply. Very few growers mix their own fertilizers. Most of the soils are of a light, sandy character and rather deep, and need constant fertilization. As the quantity of stable manure available is very small, proper soil management must include the growing of crops to be turned under. In no other way

can organic matter, in which the soils are mostly deficient, be economically supplied. Even those soils containing considerable organic matter are improved by plowing in some coarse materials. The heavier hammock soils would also be improved by deeper plowing and the turning under of coarse materials. It has been found that the growing of peanuts, cowpeas, and velvet beans on even the lightest soils increases their water-holding capacity and makes them much more productive. An old method of manuring the land, that of "stock penning," is still in vogue. By this method the stock are kept in a small inclosure, an acre or two, and the pen changed when it is thought the soil has been sufficiently enriched. This practice is only followed for a few weeks prior to planting. The practice is good, but more effort should be put forth to make stable manure through the year. A considerable quantity could be produced by keeping the stock corralled at night. At present they are not sheltered.

As is the case throughout the greater part of the State, the rural population of this area is sparse, and only a small proportion of the land is occupied and in farms. There is considerable forested land in this area, and while the turpentine operators and the saw-mills have reached all parts, there are yet a considerable number of trees left, which are gradually increasing in value.

The size of the farms is steadily decreasing. In 1880, according to the census figures, the average size of farms was 151 acres; in 1890 it had decreased to 97 acres, and with the division of large areas of land into 10-acre plots during the last few years it must now be still less. There are holdings, however, varying from 5 to 10 acres in the intensive-trucking hammock lands to hundreds of acres, while large tracts of rolling pine land exist upon which no clearings have been made.

While up to recent years the farms have been worked almost entirely by the owners, there is now an increase in lands worked by tenants. The basis of renting varies with the land and conditions, and no general plan is followed. Farm labor has become scarce and commands good wages, almost equal those for ordinary labor on public works. The labor is mostly negro—men, women, and the larger children being employed.

Land values during the last few years have been steadily rising. New settlers from the North and West are coming in all the time, but these have so far only taken small tracts of colonization companies. Ten acres is the usual size. In case of most of the lands to be acquired in this way the acreage is too small, especially on the light sandy Norfolk soils. On the better hammock lands 10 acres will keep the owner employed, with no need for extra labor except at harvesting time. In small tracts the lands sell for \$20 to \$30 an acre

for the light sandy soils and as high as \$50 to \$75 for the hammock lands. The latter, however, are not on the market. The pine lands are cleared readily, but the hammocks, with a heavy hardwood growth, are expensive to clear. Large bodies of rolling sandy pine lands and flatwoods with the marketable-size trees removed can be procured at a low price—from \$3 to \$10 an acre.

The farmers have been realizing good profits the last few seasons and are in a prosperous condition. The banking business in this section is increasing all the time, and a large part of the deposit comes from the farmers. Indications point to an increased development in this section, as the cultivated areas are rapidly being extended. General farming, with trucking, offers good, substantial returns.

By draining the low-lying lands of some of the flatwoods and low hammocks valuable trucking soils would be put in a condition for profitable agriculture. The draining of the poorly drained areas constitutes an important problem. Some of these may be drained easily, but others will require considerable expense. While there are plenty of such soils in the area, they lie so low that they are covered by water much of the time. Their drainage would be a formidable undertaking and would necessitate cooperative rather than individual effort. The upland soil areas need much improvement. Their management includes their enrichment, and this by growing those crops that will improve the soil and furnish organic matter, in which they are all mostly deficient. The poorer grades of the rolling sandy soils can be most advantageously utilized by reforesting them or by using them for stock ranges. More forage crops should be grown, the number of stock reduced, and the breeds improved. While progress is being made in most agricultural lines, there is still room for improvement.

SOILS.

The soils of Florida are designated broadly by their characteristic forest growths. Certain conditions of surface in reference to character of soil material and depth and the surface configuration and position with reference to drainage give marked differences in vegetative growths. Thus a popular classification of the soils has for a long time existed, based upon the growths found upon the land. "Pine land" and "hammock land" are terms in general use. Pine land, as the term implies, comprises land on which the tree growth consists of pine. This is mainly longleaf, there being only a scattering growth of shortleaf pine. The pine lands are recognized in several grades, according to the size and stand of trees. The longleaf pine is the main growth on the sandy types of soils, although there are some exceptions. The pine lands in the Ocala area consist

of the "rolling pine lands," including "third-rate land," "open pine woods," and "flatwoods." The first mentioned is characterized also by a scrubby growth of blackjack oak and a sod of wire-grass, as in all pine lands. The rolling pine lands with blackjack are of deep sand and excessively drained. They are held in low estimation. The "open pine woods" refer to those forested areas in which there is no undergrowth. They occur on a better grade or phase of the deep sandy soils, having usually a smoother, flat, or undulating surface, not many feet above the water table or not far to clay. This condition is not favorable to the growth of blackjack oak, but water oak and turkey oak will come in when the pine is removed. This class of sandy land is considered of fair quality. In this division there also occurs high, open pine woodsland, with heavy clay subsoil, which is almost as valuable as land that is considered "first-rate pine land," the stand being close and the trees large.

The "flatwoods" are the flat, low-lying areas in which the trees are usually slender and do not reach the usual height. There are some differences in this land. What are known as the "palmetto flatwoods" are most common. In this there is a more or less thick growth of scrub saw palmetto, with occasionally some gallberry and in open spots wire-grass. The soil is a white sand, underlain at about 2 feet by a brown substratum known as "hardpan." This hardpan is said to prevent the rise of capillary water. During rainy spells the soil above becomes very wet or covered with water, but it soon becomes dry and is very droughty. This class of land is considered almost worthless, but in other sections of the State where subirrigation systems have been put in and organic matter incorporated with the soil it has been successfully used for trucking. A type of open flatwoods occurs in association with the foregoing. It lies a little lower, is more or less wet, and instead of scrub saw palmetto the gallberry is found. The term "gallberry flat" is sometimes applied. This soil is dark colored, owing to the humus present, and in places is somewhat mucky. When drained it is considered excellent for trucking, such crops as celery, cucumbers, and lettuce doing especially well.

The term "hammock" has a rather broad meaning, but as generally used refers to the growth of hardwood. However, it often goes further, in that there must be leaf mold, and the soil darkened by the content of humus. The tree growth consists mostly of live oak, water oak, white oak, hickory, magnolia, and in the more moist places bay, gum, black ash, and cabbage palmetto, and there is a rather thick undergrowth of other vegetation.¹ "Light" and

¹ It may be said that fires have played an important part in determining the tree growth. Young hardwood growth will not stand being burned over very well, while pine is ordinarily injured but little. In the early days the Indians fired the woods, in order to hunt game more easily.

"heavy hammock" are terms that refer to the stand of vegetation present and to the texture of the soil. The "heavy hammock" is either almost impenetrable jungle, or heavy clay land. The term "light hammock" indicates sandy hammock land, or hammock land with a light growth. The predominance of any particular tree suggests such terms as "hickory and oak" hammock, "cedar hammock," etc. There are a number of terms used in connection with hammock land which refer to some characteristic feature. With reference to position, hammock land is either "low" or "high hammock." The "low hammock" is found in low positions in this area in association with swamps, being slightly above the latter, and quite often of a semiswampy character. The "high hammock" is rolling land, in which clay is found near the surface. Portions of this variety of hammock are now covered with pine, although it is said the original growth consisted of hardwood.

A geological or mineralogical designation is also applied to certain varieties of hammock. The terms "calcareous" or "noncalcareous" are also used, according to the origin of its material. In this area hammock underlain by marl is called "marl hammock." If this is a shell marl, or shells are found in the soil mass, the term "shell hammock" is used.¹

In the classification and separation of the soils found in this survey a number of factors were considered, such as the physical properties, the source of material and its mode of origin, the topographic features and position as to drainage, the characteristic vegetation, and the agricultural value. For convenience in classification and correlation soils of like properties, derivation, and position as to drainage are grouped in soil series. The series are divided into types, which differ in the texture of the component particles. Exclusive of Swamp, 17 types of soil were mapped in the Ocala area. These fall into six series.

The surface soils of the area are, with two exceptions, sandy. The members of three series consist of sand throughout the soil profile to a depth of 36 inches or more. The other three series include types having clay at or near the surface. The textural range of the sandy material is from medium to fine. Such textural variations are localized. In the western half of the area the texture of all the soils is fine, while to the east they are of coarser or medium grades.

The Ocala area, as previously mentioned in this report, is included in the limestone region of the State, limestone underlying the entire area at varying depths. The limestone is of varying composition, and consists of consolidated marine sediments belonging to the Oligocene of the Tertiary period.

¹ For more complete details of the classification of soils as given in the above paragraphs see the Florida State Geological Report, particularly the 3d and 4th annual reports.

There are two divisions of the Oligocene—the Vicksburg limestone and on top of this the Apalachicola group of formations, which include impure limestones, clays, and sands or sandstones. In this area the Apalachicola rocks have practically all been weathered to the soil. The Vicksburg is a white, soft, porous limestone, with included beds of marl and chert. The soil of the “high hammock” land has been affected more or less by material derived from cherty beds of limestone. In the low-lying areas flinty outcrops occur. Evidently the limestone has had no effect on the deep superficial beds of sand. In the western part of the area phosphatic rocks have been formed, and these underlie the sand at depths so great that they too do not have influence on the overlying surface soils.

There is a deep mantle of superficial sands overlying most of the area, except the high hammocks, from which it may have been eroded, if, indeed, it ever covered them.¹ The superficial sands fall into three series—Portsmouth, Leon, and Norfolk. These occupy low-lying flatwoods to undulating and rolling higher lands. The Portsmouth and Leon soils occupy low-lying to depressed, poorly drained areas, mostly bordering bodies of Swamp. The Portsmouth soils are situated slightly above the Swamp. Existing under poorly drained conditions, organic matter has accumulated in the soil. They are black in the surface portion and rich in organic matter, in part rather mucky. The subsoils are light-colored gray to mottled gray and yellow. These soils are in an acid condition and need liming before being suitable for most cultivated crops. They make excellent trucking soils when drained. Two types of the Portsmouth series were mapped, the sand and fine sand.

The Leon soils comprise the “palmetto flatwoods.” They are only slightly elevated above the Portsmouth, but while wet a part of the year they are very dry at other times. These are gray to nearly white soils of low organic matter in the surface portion except occasionally in the upper inch or two. Usually within about 2 feet of the surface a brown or dark-brown layer of sand, locally known as hardpan, is encountered. The brownish color and compact nature of this layer seem to be due to the presence of both organic matter and iron compounds. When wet this substratum is easily penetrated, but when it dries out it becomes compact and resists penetration by plant roots and moisture. It is believed to prevent the rise of capillary water, hence the droughty nature of the surface soil. This hardpan occurs near the top layer of the water table. The Leon sand and fine sand were mapped. Each of these includes a hammock

¹ These sands are now referred to the Pleistocene period. Heretofore they have been regarded entirely as marine sedimentary deposits of the Pleistocene, reworked by water or by the wind. There is said to be evidence that the material is residual. See State Geological Survey reports of Florida.

phase supporting a hardwood growth. The soil of the hammock areas, however, does not differ from the average, except that the hardpan substratum is deeper or entirely absent. There is also a "pond" phase representing what is known as sand ponds. Water does not remain long in these. Dog fennel is the characteristic growth of such shallow ponds.

The Norfolk soils, including the sand and fine sand, lie high and are well drained. These are grayish soils with yellowish or yellowish-gray subsoils. The types mapped constitute the main areas of deep sandy land.

The hammock soils are comprised in three series—the Parkwood, Fellowship, and Gainesville. The heavy, clayey material of these is residual from the underlying rocks. In places the sandy surface portion evidently consists of unconsolidated sedimentary material. The Parkwood soils, comprising a clay loam and fine sandy loam, are characterized by the dark-brown or brown color of the surface soils and by a marly subsoil of yellowish to nearly white color. These are strong, productive soils, but low lying and in part poorly drained.

The Fellowship series includes five types—the sand, sandy loam, fine sandy loam, clay, and clay loam. These have grayish to black and almost mucky surface soils, underlain by plastic clay, of a mottled drab, yellow, and brown color, including frequently some red. The subsoil material is dense and impervious. The low hammock areas are poorly drained, of semiswampy character, and support a hardwood growth. The high hammocks are not so well drained as might be expected in soils occurring in such sections.

The Gainesville series comprises four types in this area. These are the calcareous high hammock soils of the area. The clayey and probably some of the sandy material is derived from limestone and associated sandy rock formation. These soils are characterized by brownish-colored or slightly reddish-brown sandy surface soils, frequently with some limestone fragments on the surface and in the soil mass. These are well-drained and productive soils, having a wide range of crop adaptability. The heavy subsoil and substratum material consists of plastic clay of a yellowish-brown to mottled yellowish and drab color.

Considerable areas have been mapped as Swamp. These are low lying and more or less covered with water throughout the year. Cypress is the characteristic growth. Flood waters spread over the areas, depositing rich sediments, and much organic matter is added by the decay of the existing vegetation. The soil material of the Swamp varies greatly and no attempt was made at type separation, as much of the Swamp was covered with water at the time of the

survey. A great deal of the land consists of muck or peat overlying marl, the largest areas being indicated around Lake Panasoffkee, including the areas covered with cypress and saw grass. The muck and peat are of little value at present, owing to the fact that they are covered with water. These lie so low that drainage would be quite expensive.

The names of the different soil types and their actual and relative extents are given in the accompanying table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Norfolk fine sand.....	217,152	35.2	Gainesville fine sandy loam...	8,640	1.3
Loamy phase.....	8,640		Portsmouth sand.....	5,440	.9
Norfolk sand.....	198,528	31.3	Portsmouth fine sand.....	5,440	.9
Loamy phase.....	2,240		Fellowship fine sandy loam...	4,480	.7
Leon fine sand.....	53,120	8.3	Parkwood fine sandy loam....	1,920	.3
Swamp.....	32,640	6.1	Parkwood clay loam.....	1,280	.2
Marl subsoil phase.....	6,400		Fellowship clay.....	960	.1
Gainesville loamy sand.....	24,320	3.8	Fellowship sand.....	640	.1
Leon sand.....	23,040	3.6	Fellowship clay loam.....	640	.1
Gainesville fine sand.....	17,280	2.7			
Fellowship sandy loam.....	14,720	2.3	Total.....	641,280	.....
Gainesville sandy loam.....	11,200	2.1			
Pinewoods phase.....	2,560				

NORFOLK SAND.

The Norfolk sand consists of medium-textured loose sand that extends to a depth of 3 feet or more. This constitutes one of the extensive deep sandy types of the area. Locally the greater part of the type comes under the popular classification of "rolling pine with blackjack" land, but this vegetative classification is not applicable to the whole of the type as mapped, as will be noted later.

The Norfolk sand to an average depth of about 6 inches varies from a gray to light-gray loose sand, underlain by light yellowish gray or pale-yellow medium sand, which continues to a depth of 3 or more feet. In some places the soil continues to a depth of several feet as slightly yellowish gray sand overlying more decidedly yellow sand. In other places the color is a decided yellow to orange yellow, with sometimes a quite noticeable reddish tinge. The surface is usually loose and only slightly coherent, the coherency being due to the small organic-matter content, which also imparts the darker color. The subsoil is generally even more loose and incoherent than the soil, as it lacks the organic matter. While the texture in any one place is uniform throughout the soil profile, there are variations throughout the type as a whole. In the southeastern part of the area the type averages a little coarser, approaching at times a coarse sand, and

where it merges into the Norfolk fine sand there is a long gradation between them in which the texture approaches that of a fine sand. There are also variations in different places in the relative proportions in size of the soil particles, particularly as to the finer grades, but there are always enough of the coarser particles to impart the coarser feel.

Norfolk sand, loamy phase.—A variation in the type is shown in the eastern part of the area by means of rulings, particularly to the south and southwest of Belleview along the Seaboard Air Line Railroad. In these areas the soil is somewhat darker and the subsoil a deeper yellow and both are slightly loamy, although the lower subsoil becomes loose and incoherent. The areas appear to be of higher agricultural value than the average. (Pl. I, fig. 2.)

There are some low-lying areas in depressions associated with the high hammock soils near Ocala that support a hammock growth. These areas have considerable leaf mold in the surface soil, rendering it darker than the typical hammock phase, although otherwise identical with it. Another vegetative growth is also indicated. This is in areas of scrub outlined from the remainder of the type, which are in marked contrast with the surrounding areas of the type, owing to the different vegetation, being covered by stunted evergreen oaks and a shortleaf locally called "spruce pine." In these areas a marked contrast to the average of the type is the dazzling white appearance of the surface, which upon examination is found to be a mere veneer not over 2 inches deep, under which is encountered bright or ochereous-yellow colored sand. In texture and structure it does not vary from the average of the type. The largest area is known as the Big Scrub. This lies southward from Ocala.

While the greater part of the Norfolk sand has a substratum of sand reaching to a depth of many feet, there are some areas in which the sand is not over 4 to 6 feet in depth. A typical section of this kind is that northwest of Ocala, having a flat or slightly undulating surface, in which are found frequent outcrops of flinty limestone and around these some loose stone. In this section either the sand directly overlies the rocks or there is an intervening clay stratum. Rock outcrops occur occasionally in the lower and flat areas of the type and around the rims of some sinks. They are very rarely encountered in the rolling areas.

The Norfolk sand is, next to the Norfolk fine sand, the most extensively developed soil type in the area surveyed. It occurs in the eastern half of the area and in Marion and Sumter Counties. It is practically in one large, connected but irregular body, being limited by areas of flatwoods and swamps on its borders and interiorly broken by the projection of the high hammock lands as islands, as it were, and by the soils occurring in the depressed areas of sinks and basins.

The topography of the Norfolk sand varies from nearly flat or gently undulating to rolling or low hilly, rolling being the most common surface configuration. In looking over the areas of this soil it has a billowy appearance to some extent, but the ridges are not continuous, being rather a heterogeneous collection of low sandy knobs, conspicuous because of the depressions between, which are the result of the dissolution of the underlying limestones forming sinks or basins. The elevation ranges from 50 to 100 feet above sea level, the undulating areas averaging a little more than 10 feet or so, while in the more rolling areas the change in elevation reaches 20 to 40 or 50 feet.

The Norfolk sand consists of a superficial mantle of sand of sedimentary origin laid down as a marine deposit during the Pleistocene period, when this part of Florida was submerged.¹

The drainage of the Norfolk sand is excessive in that, because of its open, sandy character, the rains falling upon it pass quickly downward, seeking the permanent water-table levels or seeping into the sinks or to the swamps. The type maintains a small moisture supply at all times, but during hot, dry spells the crops suffer. Its moisture-holding capacity is greatly increased by the incorporation of organic matter. So readily does water pass into this soil that its cultivation is not interfered with by rains.

The Norfolk sand in the main constitutes one of the "pine lands" types of soil. Because of its generally rolling surface, it is known locally as "rolling pine lands." In addition to the pines some blackjack oaks are found over much of the land, the latter taking hold when the longleaf pine is removed. The pines attain a fair size, but the stand is rather thin. The pine lands are rated in classes according to the relative rate of growth of the trees, and this class of land comes in as third rate, although some of the better parts will grade as second rate. The more loamy areas support the growth spoken of as open pine woods, in which there is no undergrowth and blackjack does not come in to any important extent. The flatter or low-lying undulating areas, because of nearness to the water table, also support some post oak, water oak, and turkey oak. Where the turkey oak grows the land is considered of better quality. Such areas are found from Santos south along the Seaboard Air Line Railway.

As previously mentioned, there are two other phases of this type, the hammock and the scrub areas. The former supports large trees of water oak and live oak, magnolia, hickory, cabbage palmetto, and some others. This growth is influenced by the better moisture condi-

¹The origin of these superficial sands is questioned. While their sedimentary origin is accepted by most geologists, there are some who consider them of residual origin or formed in situ from sedimentary rocks, the age being unknown because of lack of fossil remains. See Florida Geological Survey reports.

tions, the roots being able to reach the permanent water table. The scrub areas are characterized by a stunted growth of evergreen oaks and spruce pine. These areas are sharply separated from those of the rolling lands with pine and blackjack growth. There is apparently no difference in the soil to the depths examined, and no conclusive explanation for one growth taking hold to the exclusion of another can be given here. It was noticed, however, that the subsoil in the scrub areas was generally more moist, and this may account for the difference in the vegetation. There was no topographic change, the growth covering the higher as well as the lower situations. These areas of scrub are regarded as very poor and no attempt is made to cultivate them. There is no wire-grass growth in the scrub areas, but on the rest of the type there is a good wire-grass sod that early in the season affords fair pasturage for cattle, contributing somewhat to the value of the land.

The main value of the type has been its growth of longleaf pine, which usually is first worked for turpentine during a period of years and then cut and sawed into lumber. With the trees removed the greater part of this type has little value and is not usually desired for farming. The population over this type is sparse and many sections are occupied solely by negroes.

Some development is taking place on the better areas of the Norfolk sand near railroads, but there is not a wide range of crops produced. Naturally the type is one of low productive value. Fertilization is necessary to produce anything approaching good yields. The soil will make a small yield of corn—about 10 bushels to the acre. Velvet beans grow well upon it and are an important crop. Cowpeas are also grown, being cut for hay. Crabgrass coming into the corn late in the season is usually cut for hay. Sweet potatoes are grown in small patches to supply the family needs. Watermelons constitute the money crop on this soil and large acreages are being devoted to it, from which considerable revenue is derived. Because of the wilt disease, however, the land can not be replanted to watermelons for a number of years. Cantaloupes are grown on some of the better areas, and with the advent of new settlers the production of other truck crops, particularly tomatoes, is being attempted. The better parts of the type, when the depth to the clay or water is not too great, are well suited to vegetable growing, but the application of organic manures in liberal quantity, as well as complete commercial fertilizer mixtures, are necessary on the best of this land. By plowing under green manuring crops, especially the legumes, this soil can be greatly improved. Cowpeas are useful for this purpose. The velvet bean makes a heavy growth, shades the ground, and is an excellent soil improver, especially when plowed in. A source of income is the

growing of velvet beans for seed. The growing of this crop is general on the type.

Areas of the Norfolk sand in small tracts are sold for \$10 to \$25 an acre, but the greater part of the type is held at much lower prices.

NORFOLK FINE SAND.

The Norfolk fine sand is the most extensive soil in the area. It consists of a mantle of fine sand more than 3 feet deep. Slight variations occur in the type, but the surface 6 inches usually consists of a gray to yellowish-gray, loose fine sand. The grayish color is caused by the small organic-matter content, which in places is sufficient to make it quite dark, especially in the lower situations. Besides affecting the color above, this organic matter has a binding effect, making the soil, though loose, somewhat coherent. The soil below the surface 6 inches is of similar texture, but, lacking organic matter, it is usually a little more loose and incoherent, especially in the lower depths. The prevailing color of the soil is gray, yellowish gray, or pale yellow, but there are variations, in some places to a decided yellow or ochery yellow, in others to a brownish or orange-yellow color, and occasionally even to a reddish color.

The type is free of stone as a rule, but occasionally around sinks there may be found outcrops of flinty ledges of the limestone formation. There is also a belt of flat to undulating country extending southeast from Standard and Earlybird in which there are frequent outcrops of the flinty rocks and some loose stone on the surface. Clay is found at 4 to 6 feet in places, but the soil is of the same texture and character as the general average of the type, though a little lighter in color, being light yellowish or grayish yellow, approaching the color of the Leon fine sand. In addition, it is characterized by a scattering growth of saw palmetto, which is rarely seen on most of the Norfolk fine sand.

Slight variations in texture are found in different parts of the type. While it all averages a fine sand, it tends in places toward a coarser texture, and in the southwestern part of the area approaches that of a very fine sand.

The Norfolk fine sand is confined to the western half of the area, in Levy, Marion, and Citrus Counties. It is found in practically one large, connected body, broken to some extent by areas of other soil types.

The topography of the type is mostly rolling, a large part of it constituting the highest rolling lands in the area. The surface is for the most part irregular and choppy, owing to the presence of depressed basins caused by the solution of limestone beds and the falling in of caverns. The change in elevation from the sunken

areas to the higher lands surrounding ranges from 20 to more than 100 feet. Most of the basins occur at an elevation of 40 to 60 feet above sea level, but there are some that are as low as 10 to 20 feet above. The average elevation of the tops of the knolls is 100 feet or more above sea level and the highest elevation of the area occurs in this type, being 220 feet above sea level. This point is west of Hernando. In some parts, especially east of Dunnellon and in the vicinity of Earlybird, the surface smooths out to gently undulating.

There are no surface streams found within this type, with the exception of Wekiwa Creek, or Blue Spring Run, which is really a subterranean stream coming to the surface. The sand is porous and all the water falling upon it passes readily downward to the permanent water table or seeps into the sinks and subterranean channels in the porous limestones beneath.

This soil holds only a small amount of moisture, and in its present condition will not support crops during dry, hot weather, but by increasing the organic-matter content it can be made to maintain a more adequate supply of moisture.

The Norfolk fine sand, like the Norfolk sand, is a superficial mantle of sand, most probably of Pleistocene age. This soil overlies the extensive hard-rock phosphate beds of this section of the State.

There is very little agricultural development on this soil, partly because it is naturally a thin soil of low productivity. For good yields all crops have to be heavily fertilized with complete mixtures or barnyard manure. It is held in large tracts by the phosphate mining companies and as interest centers in the mining operations no effort is put forth on the soil. Large tracts of this land have been completely deforested, the wood being used for the drying of the phosphate rock. Around mines the country presents a desolate appearance.

On the flatter areas of the type east of Dunnellon and along the Ocala & Southwestern Railroad there are some lands in cultivation. Large acreages are being put in watermelons, for which this soil is well adapted. Velvet beans and cowpeas are also grown, and a small yield of corn is obtained. Sweet potatoes do fairly well. Vegetables do well on some of the better spots, but no market gardening is done on this soil. With an overhead system of irrigation the better areas would be well suited for gardening. Its greatest need is the incorporation of organic matter. Velvet beans and cowpeas are the best crops to produce. Corn and melons have to be fertilized, the latter requiring heavy applications.

The principal tree growth on this land is longleaf pine, which attains a fair size and a moderate stand. The blackjack oak occurs with the pine, and when the latter is cut the former occupies the

land. There are some areas of open pine woods, especially on the better parts of this type, that support a sod of wire grass, which affords good grazing early in the season. The value of the land is low—only a few dollars an acre.

Norfolk fine sand, loamy phase.—While the type as a whole is a loose, incoherent sand, there are areas occurring in the depressions, especially in Citrus County, in which the soil is affected by wash and is a little more loamy than the average. There are also indicated some areas near Dunnellon which, while not in depressions, are a little more loamy, and in the vicinity of Heidtville there is a large area having a generally flat surface that is also somewhat loamy, the clay not being very far beneath the surface. Two large areas of this phase, lying near Elecia and Inverness, in Citrus County, were also mapped.

GAINESVILLE LOAMY SAND.

The surface soil of the Gainesville loamy sand consists of about 10 inches of a grayish-brown to brown, medium-textured loamy sand, ranging to reddish brown in places. The subsoil is a yellowish-brown or brown to reddish-brown loamy sand, which becomes a little more loamy with depth, usually changing within 36 inches to a sticky sand or sandy loam, which in turn grades below into a substratum of friable sandy clay. In some places, however, the sandy clay is encountered within 24 inches of the surface. It is of a brownish-yellow color and quite frequently has a reddish tinge. In many places there is 3 or 4 inches beneath the surface a dark-brown to brownish-black, compact layer having something the nature of hardpan, although not cemented, the color being caused by the staining of the soil grains by organic or ferruginous matter.

As mapped the type includes some areas of a loose sand, representing the Gainesville sand, which were not separated, owing to their small extent. Some included patches closely resemble the Norfolk soils in having a somewhat grayish color in the surface portion and yellowish color beneath, and in being rather loose and incoherent in structure from the surface downward. Areas are encountered in which the surface is loamy and close structured, while the subsoil is not especially loamy and is loose and incoherent in the lower part. Limestone fragments are quite commonly found in the subsoil and the bedrock itself may occasionally be reached within the 3-foot section. Small areas occur where limestone fragments are scattered upon the surface, as well as throughout the soil and subsoil.

There is some variation in texture in the Gainesville loamy sand from place to place. The sand particles of the soil are irregular shaped and rather sharp, and generally enough of these are of suffi-

cient size to give a rather coarse feel, making the texture coarse medium, but it varies, on the other hand, to a fine medium texture, with a small range in the size of soil grains.

The loamy sand is the most extensive of the Gainesville soils. Comparatively large areas occur in the eastern part of the survey in Marion and Sumter Counties. The greatest development is around Ocala, and there are large areas around Belleview, Summerfield, and Oxford. It forms high hammock land, occupying the broad, gently sloping, arched areas of hammock, mostly between elevations of 90 and 100 feet above sea level. Some of the areas are quite broad and flat, but usually there is some slope. This surface is further modified by the presence of depressions or large basins and by sink holes. There is an entire lack of surface streams, the drainage being accomplished by the water percolating downward and finding outlets into the sink holes or subterranean channels. The soil texture and the underlying rocks are porous, so that percolation is accomplished readily. All of this land is thoroughly—some of it excessively—drained, although most of the type, owing to its loamy character and heavy clay subsoil, holds moderate supplies of moisture. None of it is found wet.

This soil material is entirely or mainly of residual origin, having been derived from the weathering of limestones of the Vicksburg group and the sandstone formations above it. Some of the sand in the surface portion may represent original unconsolidated sedimentary material, but the brownish-colored and clayey material undoubtedly is a residual product from the underlying rock.

The Gainesville loamy sand is known locally as "hammock land," and when the soil mass is dark brown or has a reddish cast, as it is in spots, it is spoken of as "chocolate hammock." It also, in part, at least, with the other Gainesville soils, comes under the term "calcareous hammock" because of the calcareous origin of its materials. It is also known as "mixed hammock," because its growth consists of mixed hardwood and pine, though hardwood predominates.

A large part of this soil is cleared and under cultivation. It is easy to cultivate, productive, and adapted to a wide range of crops. All the general farm crops are grown upon it. Corn gives 25 or more bushels to the acre on the average, but when it follows a highly fertilized trucking crop the yields run much higher. Either peanuts or velvet beans are grown with the corn. The velvet beans are generally put in as a separate crop, and a yield of 15 to 20 bushels of beans to the acre is considered good. Sugar cane grown on this soil makes, as a rule, a dark-colored and rather strong sirup. The yield, however, is high.

Winter oats are grown and are cut and cured for hay. They make only an ordinary growth, not doing so well as on the heavy clay hammock soils. The beggarweed thrives on this soil, making a heavy growth. Cowpeas also do well upon it, being grown for hay and to some extent as a soil improver. Irish potatoes, especially on the deeper sandy areas of the type, have not paid as a commercial crop, but sweet potatoes do well.

Trucking is done more largely on this soil than on any other. It has a wide range of adaptability and is a warm, early soil. Cantaloupes have been and are still an important crop. Yields of 100 crates to the acre are obtained with the use of 600 to 700 pounds of commercial fertilizer. The Rocky Ford variety is grown exclusively and is of excellent quality. Cucumbers, snap beans, and eggplants are other truck crops that succeed. Watermelons yield as high as a carload to the acre, while one-half carload is considered a fair yield on most soils. At least two crops are taken every year from this soil. Where truck crops are grown the common practice is to follow with corn and peanuts. Cowpeas sometimes succeed cantaloupes or watermelons, and after these later planted crops mature a cutting of crab grass can be obtained for hay. Where general farming is practiced corn and peanuts are grown, and then the crab grass is cut, or beggarweed, if it happens to come in. The peanut crop is either harvested or left on the ground as feed for hogs.

This land is held in good-sized farms, and the owners generally are prosperous. It lies close to the towns and railroads and is held at prices ranging ordinarily from \$20 to \$75 an acre, and much of it can not be purchased even at the higher figure.

Mechanical analyses of typical samples of the soil and subsoil of the Gainesville loamy sand gave the following results:

Mechanical analyses of Gainesville loamy sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
260811.....	Soil.....	0.6	12.9	26.5	40.1	10.4	4.3	5.2
260812.....	Subsoil.....	.2	12.8	25.6	39.4	10.7	3.8	7.5

GAINESVILLE FINE SAND.

The surface soil of the Gainesville fine sand consists of 5 to 8 inches of a brown or brownish-yellow fine sand to loamy fine sand, underlain by brownish-yellow loamy fine sand that becomes lighter colored with depth. Like the Norfolk fine sand, it is often loose and incoherent in the lower depths. Just below the surface of a great

deal of the type there is a compact dark layer, resembling a hardpan, which contains considerable organic matter. When dry this compact layer breaks up into slabby pieces which soon crumble. The type also includes some areas of gray-colored surface material and light-colored subsoil which is only slightly loamy, representing rather a gradational phase between this type and the Norfolk fine sand.

The Gainesville fine sand occurs in the western part of the area, associated with the Norfolk fine sand. It is found in a belt entering at the northwest corner of the area from Levy County and extending southeast to Juliette. Around Dunnellon there is another area, the two areas being separated by a body of Norfolk fine sand. There are also some small areas in Citrus County, two of which occupy islands in Lake Tsala Apopka and others the domelike tops of knolls. The topography of the larger areas is that of the Norfolk fine sand, the surface being rolling and somewhat ridgy or hilly and marked by sunken areas, in some of which are ponds. This land is well drained and lies well for cultivation. There is no surface run-off, the waters readily passing through to lower levels. It is, however, more retentive of moisture than the Norfolk fine sand, though regarded as a droughty soil.

The origin of this type is not clear. It is probably residual, at least in part from the Vicksburg limestone or an associated arenaceous rock. In some places small fragments of a ferruginous sandy rock occur on the surface. These show a rather weak cementation or a state of partial decomposition, being readily broken down to sand. In the lower depths the formation becomes somewhat sticky and clay is sometimes found, indicating residual origin, for it is believed that most of the clay material of the area is residual from the underlying rocks.

There has been a little development of agriculture on this type of soil, some of the land having been cleared and occupied early in the settlement of this region. Fair yields are obtained. Corn gives 10 to 15 bushels per acre without fertilization. Oats, cowpeas, and velvet beans are grown and cut for hay. Crab grass, crowfoot, and sandspur come in after the corn, and a fair crop of hay is cut in the fall. Sea-island cotton has been grown on this land, giving yields as high as 500 pounds of seed cotton per acre. Before the freeze of 1894-95 there were orange groves on most of the farms, from which some profit was derived. No groves remain now. While the soil does fairly well, farmers say it will not stand continuous cropping and that it is a good practice, and one followed generally, to let the land lie idle every other year and turn under the growth of weeds and grasses. The same object could be attained by growing cover crops and plowing them under while cultivating the land every year.

Rather liberal fertilizer applications are necessary for best results with all crops.

The areas in Tsala Apopka Lake are devoted to citrus fruits, which do well. Here the surface is not far above the water table. These areas as mapped are rather variable, including areas of Norfolk fine sand, Gainesville fine sandy loam, and Gainesville fine sand so intricately associated as to preclude satisfactory separation on the scale used. The dominant soil, however, is the Gainesville fine sand. In these areas some limestone fragments are present.

The Gainesville fine sand supports the type of vegetation known as "open pine woods," the growth being longleaf pine, which attains a good size and is fairly close. There is no undergrowth except a strong sod of wire grass.

Mechanical analyses of typical samples of the soil and subsoil gave the following results:

Mechanical analyses of Gainesville 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.	<i>Per cent.</i>
260817.....	Soil.....	0.2	1.4	8.4	71.1	10.6	2.5	5.7
260818.....	Subsoil.....	.0	1.7	9.7	73.5	8.1	2.3	5.0

GAINESVILLE SANDY LOAM.

The Gainesville sandy loam is a rather variable type in color, depth of soil, and vegetative growth. There are two kinds of vegetation on this land—hardwood and pine. The hardwood hammock land averages a darker-colored soil with less depth to the clay subsoil than the pine-woods phase, but there are many places in which there is very little difference, as far as the appearance of the soil is concerned, between the material of the typical soil and the pine phase, each grading into the other. The hammock land varies from brown to yellowish-brown medium sand to loamy sand or light sandy loam. Included in these areas are spots of gray sand, so that the surface is quite variable in color and texture. The depth of the soil ranges from 8 to 24 inches. Beneath this there is encountered a brownish-yellow clay, varying from sandy to stiff and plastic, which generally becomes heavier with depth. In places the underlying rock is found at the surface or above a depth of 4 or 5 feet. In the subsoil, especially in the lower part, occur limestone fragments some of which have weathered to an advanced stage. Fragments of the same kind are also found scattered over the surface in spots. In places the subsoil has a decidedly brownish color. There is also a variation showing mottled brown

and yellow and some bluish drab, the latter approaching that of the closely related Fellowship type, into which it grades. A characteristic of this type is the irregularity in shape and size of the soil grains. While it is composed largely of sand particles of medium grade, there are enough of the larger grades, with irregular or angular shape, to give a coarse feel to the soil as a whole.

The Gainesville sandy loam is of comparatively small extent. Its largest development is on the high hammock lands immediately south of Ocala. Except in the case of the area at Coleman and a few others, it occupies the "high hammock lands." These are irregular-shaped ridges or elevated sections marked by large depressions and sink holes, which have no surface outlets. In part they are distinct ridges. The highest elevations range from 100 to 150 feet above sea level. The slopes are smooth and comparatively gentle. They erode badly, however, if care is not taken in their cultivation.

The Gainesville sandy loam has good surface drainage, which is effected through the numerous sink holes and larger depressions, so that there is no need for artificial drainage. It is fairly retentive of moisture, as with its clay subsoil it maintains generally a sufficient supply of moisture to grow and mature all the general farm crops.

The Gainesville sandy loam is, on the high hammocks, largely, if not entirely, of residual origin, having been derived from limestone of the Vicksburg group and the associated sandy formations. The lower areas of the pine-woods phase have a subsoil largely residual from limestone, but the soil portion may be to some extent of sedimentary origin.

The Gainesville sandy loam is one of the better soil types of the area and much of it is cleared and under cultivation. It produces good yields of all the general farm crops and is devoted to trucking as well. It is a warm soil as a rule and crops develop rapidly on it. Sea-island cotton used to be grown on this soil type and gave fair yields. The shallower and heavier phases are especially well adapted to cabbage. Tomatoes and snap beans also yield profitably. Cucumbers and cantaloupes, particularly the latter, do well on this soil, and watermelons are grown to some extent on the deeper and more sandy areas. Fertilizers in large quantities are required for all these crops, but their application is repaid in the size and quality of the yields. All of the type should be cleared and cultivated, and with a system including general farming and truck growing, thus affording a broad crop rotation, the farmers should be successful. This soil, for the most part, at least, would be greatly benefited by the use of organic manures. All the barnyard manure possible should be applied and this should be supplemented by plowing under green crops. Beggarweed, which grows well upon this soil, is especially desirable for this purpose.

The vegetative growth on the Gainesville sandy loam varies. The hammock growth is of mixed character, including both hardwood and pine, the former consisting of live oak, red oak, hickory, magnolia, sweet gum, cabbage palmetto, and other species. The pine growth is scattering, the longleaf pine growing large. There is also shortleaf pine in some areas.

The value of this land ranges from \$25 to \$75 an acre, depending upon location. The greater part is located well in reference to railroad facilities.

Gainesville sandy loam, pine-woods phase.—The pine-woods phase of the Gainesville sandy loam resembles that of the Gainesville fine sandy loam, except in texture. It consists of a gray or yellowish-gray sand, changing in places to yellowish or snuff-colored to brownish-yellow medium sand, averaging between 15 and 24 inches in depth, and resting upon a brownish-yellow clay, varying from sandy to stiff and plastic. There also occur in this clay soil, especially where near the rock, some rotten limestone fragments of gray to yellowish-gray color, giving the clay a speckled or mottled appearance. Flinty outcrops of the limestone formation are also to be seen, and occasionally some loose, irregular blocks of limestone. This phase has a more nearly level topography than the typical soil and supports a rather close growth of longleaf pine, which reaches a good size. Areas of the pine-woods phase occur near Coleman, in Sumter County.

Results of mechanical analyses of samples of the typical soil and subsoil of this type are given below:

Mechanical analyses of Gainesville 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.	<i>Per cent.</i>
260823.....	Soil.....	0.8	14.0	23.5	41.4	11.8	5.5	3.1
260824.....	Subsoil.....	.6	9.3	14.8	29.7	8.3	4.9	32.4

GAINESVILLE FINE SANDY LOAM.

The surface soil of the Gainesville fine sandy loam consists of a few inches of gray to dark-gray fine sand varying in places to a light or grayish-brown fine sand and again to a yellowish-gray or yellow fine sand, usually slightly coherent. The depth of this soil mantle varies considerably, and within short distances ranging from 8 or 10 inches to 3 feet or more, but usually the clay subsoil is encountered at 15 to 24 inches below the surface. Areas where the soil exceeded 3 feet in depth are common, but are generally too small to show on the map, and for this reason were not separated. The subsoil consists of a yellow to brownish-yellow or light-buff clay, varying from

a fine sandy clay to stiff plastic clay, the former being generally friable from the sand intermingled with it. Usually the clay content increases with depth and the structure becomes more plastic. Small fragments of rotten limestone are frequently found in the subsoil, especially in those places where limestone outcrops or lies near the surface. The quantity of this rotten rock material generally increases with depth. Around Lecanto the type has a darker-colored surface and is somewhat loamy in places, being a light sandy loam of dark-brown color, underlain by brownish-yellow or buff sandy to stiff plastic clay. Throughout the extent of the type are to be seen outcrops of flinty ledges of the Vicksburg formation and about these outcrops irregular fragments and blocks of the flinty rock over the surface. The rocky spots, while having in some instances enough rock to interfere with cultivation, were too small to indicate separately on the map.

The Gainesville fine sandy loam is of comparatively small extent. The areas are scattered over the western and central parts of the survey, where they are associated with other fine-textured soils, and they occur also with the high hammock lands in the northern part, from York to Earlybird. There is also an area on the extreme northern boundary west of Standard. In the southwestern part of the area, in the vicinity of Lecanto, in Citrus County, there is a considerable body broken by other soil types. There are also a few small areas associated with the soils along the Withlacoochee River. The greater part of the type is flat to gently undulating. With the hammock lands, it occupies the flat or undulating areas between the high hammocks as extensions from those slopes occurring between the 70-foot and 90-foot contours. The area around Lecanto has considerable relief, being conspicuously rolling, ranging from 20 feet elevation in sink holes to slightly over 100 feet above sea level on the hilltops. All the areas are marked by sink holes of varying sizes and depths, caused by the removal of limestone by solution, the type resting upon limestone formations at comparatively slight depths.

The Gainesville fine sandy loam has good drainage, the surface waters percolating either directly downward into the porous limestones or into the sink holes. The sandy soil mantle, because of its being underlain by clay, is fairly retentive of moisture.

The subsoil of the Gainesville fine sandy loam is probably for the most part, if not entirely, of residual origin, from the Vicksburg group of limestones. The rocks have weathered irregularly, and the more resistant parts protrude here and there above the surface. In some areas partially weathered limestone is occasionally found on the surface and in the soil mass. The surface sandy mantle is of doubtful origin. It is possible that much of it is water-transported

material deposited over the residual clayey subsoil. In part it may also be residual, representing the siliceous parts of the parent limestone.

This type was one of the earliest soils in the area to be cleared and cultivated. It had good natural drainage and the light soil was easy to cultivate and fairly productive. It is now devoted entirely to general farm crops and makes fair yields. It is a soil that would be well suited to trucking, but its location, with the exception of a few areas, is at present too far from shipping points. Having a clay subsoil, it would be adapted to citrus-fruit growing, providing the situation were right. None of the areas, except those along the Withlacoochee, lie near bodies of water.

The type is partly forested, the growth being longleaf pine, fairly thick and of good size. The forested areas are characteristic of open pine woods, there being no shrubby undergrowth. It supports a good sod of wire grass.

As the lands are mostly remote from towns and railroads, their price is not high, probably ranging from \$10 to \$25 an acre, although most of the areas have been cleared and occupied as farms.

The average results of mechanical analyses of samples of the soil and subsoil of the Gainesville fine sandy loam are given in the subjoined table:

Mechanical analyses of Gainesville 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.	<i>Per cent.</i>
260813, 260821.	Soil.....	0.4	3.1	9.7	54.1	22.5	4.5	5.7
260814, 260822.	Subsoil.....	.2	1.8	6.1	36.3	13.0	8.7	33.9

The following sample contained more than one-half of 1 per cent calcium carbonate (CaCO_3): No. 260814, 3 per cent.

FELLOWSHIP CLAY LOAM.

The Fellowship clay loam is a variable type of soil. It ranges from a clay loam to clay, often having a surface covering 3 to 5 inches deep of sand, loamy sand, or even sandy loam. Over the greater part of the type it consists of 4 or 5 inches of a clay loam, with some sand, varying in color from black to brown or brownish gray. The subsoil is a stiff, plastic clay, somewhat sandy in places, becoming heavier and more plastic with increase in depth. The subsoil color ranges from black to bluish drab, becoming lighter drab with depth. In places it is almost a gray clay, very sticky and gumbolike. The clay contains small particles of light-colored sandy rock and possibly some fragments of limestone. In places there are small spots where the subsoil is exceedingly stony. There usually occur scattered upon

the surface in small quantities fragments of angular or subangular, spongy-looking sandstone, ranging in size from small chips to fragments several inches in diameter.

The Fellowship clay loam is of small extent, consisting of small areas on the high hammocks south and west of Ocala. It is typically developed on the slopes, and these are about the steepest in the area. While this land lies so that the surface run-off is good, yet because of its close, clayey character it holds a great deal of water, becoming puttylike, boggy, and difficult to handle when wet and hard to break up when dry. Gullies are easily eroded on the slopes if care is not taken to prevent their formation.

The Fellowship clay loam is of residual origin. A variety of rocks belonging to the Oligocene formations seem to have entered into its composition. Part of the material appears to be derived from limestone beds and part from sandstone, probably more or less calcareous, associated with the limestone.

The Fellowship clay loam, because of its generally moist condition and close character, is a cold and comparatively late soil, but it is nevertheless very strong and productive. It supports a strong grass sod, broom sedge particularly making a luxuriant growth. Besides the grasses, oats make a good growth and yield well. It is said to be excellent for cabbage. Snap beans do well upon it. With the exception of one area, this soil is found away from railroads and is mostly in grass for pasturage. It supports a mixed growth of hardwoods and longleaf and shortleaf pine.

In managing this type the aim should be to loosen it up and deepen the surface soil. This can be done by plowing in all the coarse litter possible and by the use of lime. A part of the soil would undoubtedly be benefited by subsoiling, which, on account of the intractability of the clay, would have to be done gradually. The area near Ocala has a high value and is not on the market.

Results of mechanical analyses of samples of the soil and subsoil of this type are as follows:

Mechanical analyses of Fellowship clay 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.	<i>Per cent.</i>
260861.....	Soil.....	1.3	10.2	12.7	25.1	8.0	14.2	28.3
260862.....	Subsoil.....	.3	2.6	5.8	9.5	6.1	13.4	62.0

FELLOWSHIP SANDY LOAM.

The Fellowship sandy loam is found both as low and high hammock, but there is no essential difference in the soil conditions, ex-

cept that the high hammock land now supports a growth of pine. There is, however, considerable variation throughout the type, particularly in depth of the surface soil and to some extent in texture. These variations occur within short distances. The type consists of a sandy mantle overlying mottled clays. The surface soil in most places is between 6 inches and 2 feet deep, but occasionally it is deeper. The first few inches of the surface soil usually consist of black to brownish-black sand or loamy sand rich in vegetable matter. The texture varies in places to a sandy loam. Beneath this dark surface portion the color becomes lighter, the subsurface consisting of a brownish-yellow to drab medium sand, which is frequently slightly sticky in its lower part. In some places the surface portion is gray, grayish drab, or dark gray in color in the upper part and light drab below. Cultivated fields soon assume a dull-gray or drab color on the surface and differ markedly in appearance from the surrounding gray sand of other types. The subsoil consists for the most part of a mottled drab and yellow plastic sandy clay. Generally the mottling increases with depth. Occasionally there are some streaks or mottlings of brick-red color, but, except in small spots, the red mottling is not conspicuous. On examination the drab-colored portion of the clay is found to consist mostly of clay particles and to be very stiff and plastic, while the yellow and brown colored material is sandy, showing in places, especially on the high hammocks, decomposing fragments of sandy rock. In places the clay is quite sandy, and yet very stiff, while in other places there is very little sand and the clay is stiff, sticky, and plastic. The clay is always moist, and often has a greasy feel in addition to its plasticity. The clay content, as a rule, increases somewhat with depth. In some areas the subsoil includes sandy strata throughout the heavier clay and vice versa. In road cuts the material has a characteristic dingy bluish-drab and brown mottled color. The roads when wet become very sticky, and are sometimes described as "clabber." When dry, however, they become smooth and very hard.

The Fellowship sandy loam has a larger development than any other of the Fellowship soils. While its areas are not widely distributed, they are extensive. The high hammock area lies in two bodies, one immediately south of Ocala and the other northwest of Ocala in the vicinity of Fellowship Church. The largest development of the low hammock areas of this type is east of Ocala, where it is associated with the swamp of Silver Springs Run and Dead River Swamp. A few small areas are found in the southeastern part of the area, in Sumter County, around the swamps of Panasoffkee Lake and Withlacoochee River.

The high hammock areas have a hilly or irregular, ridgy topography, marked in part by steep slopes. The range above sea level is

from 90 to 180 feet. The ridges have been eroded to some extent, gullies or draws having been washed out. The drainage waters find their way in short, intermittent branches, which end at the bottom of the slope in sink-hole ponds or in areas of porous sands. The surface admits of ready run-off, but as the surface is a sand with underlying impervious clay there is considerable seepage and these slopes are more or less wet and thus in part are not well drained.

The low hammock areas lie only slightly above the swamps, being in part semiswampy, and in depressions actually swampy. They are sufficiently wet to favor the growth of cypress. After rainy spells water stands upon the surface for considerable periods or until it can evaporate. Drainage of these areas is necessary before they can be cultivated.

The material of the Fellowship sandy loam is apparently mainly of residual origin. The rocks are believed to have consisted mainly of sandstone and argillaceous rocks, along with some limestone. Weathering has not been complete, as some rock fragments are found. In small spots are found quantities of sandy rock fragments varying from a grayish to brownish color, some of which are evidently ferruginous. There are also some outcrops on the surface, which, with the loose pieces, are sufficient to make the soil unfit for cultivation, but this condition occurs only over a few square rods. There occur in the low hammocks, also, rock outcrops and loose fragments of stone.

The larger part of the Fellowship sandy loam is in forest. It supports both a hardwood and a pine growth. The low hammocks have in part a mixed growth, there being scattering longleaf pine and some shortleaf pine among the hardwoods. The hammock growth is heavy, the trees being large and the undergrowth in places very thick. Live oak and water oak are most common, with some white oak, red oaks, magnolia, holly, bay, hickory, ash, and gum. Conspicuous among the trees is the large cabbage palmetto. In swampy depressions cypress is found. Some parts are covered by open pine woods, there being no undergrowth, except broom sedge or wire grass, the latter on the better drained parts. Often where pine is found it is second growth, the land having been cultivated and later abandoned and allowed to reforest itself. A considerable area of the high hammock land has at some time in the past been cultivated, but it, too, has reverted to forest and pine has taken possession of it. The greater part of the high hammock is covered with pine, some areas with longleaf and others with shortleaf pine. The longleaf and shortleaf pines are also intermingled on some areas. There is also some hardwood growth on these higher areas, particularly in the draws. The pine-woods areas are called hammock land because it is said they originally supported a hardwood growth, the pine representing a second growth.

The growth on the high hammocks is also heavy. The oak trees are large. The pine growth is very thick and grows to a good height and size. Broom sedge takes possession of old fields.

Before the freeze of 1895 a considerable acreage of the high hammock, as well as of the low hammock land, was planted to citrus fruits, this being regarded as especially good soil for oranges, but after the freeze the lands were abandoned, and the groves were not reestablished.

The Fellowship sandy loam is considered one of the strong, productive soils of the area and is adapted to the general farm crops and to some of the special trucking crops. All the type, including the high hammocks, needs artificial drainage. The high hammocks would be greatly improved by tiling, this not only removing water quicker than it is now accomplished, but aerating the soil as well.

While this soil is largely forested and relatively little cultivated, it has a high value and is not on the market.

The average results of mechanical analyses of the soil and subsoil of the Fellowship sandy loam are given in the subjoined table:

Mechanical analyses of Fellowship 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.	<i>Per cent.</i>
260839, 260849, 260855..	Soil.....	0.8	9.2	19.5	37.4	18.2	10.8	4.5
260840, 260850, 260856..	Subsoil..	1.0	5.1	12.4	26.1	11.8	8.1	34.4

FELLOWSHIP FINE SANDY LOAM.

The Fellowship fine sandy loam is similar in all respects to the Fellowship sandy loam, except that it averages finer in texture. The surface soil ranges in depth from 6 inches to 2 feet or more, the variation occurring frequently within short distances. Typically the upper few inches of the surface soil consist of a black to brownish-black fine sand to loamy fine sand, more or less mucky, owing to the high content of organic matter. In places the texture varies to a light fine sandy loam. Below this the color gradually changes to a drab, brownish drab, and sometimes slightly yellowish drab. When cultivated the material becomes lighter in color as the organic matter is depleted and the soil assumes a peculiar drab or grayish color. The subsurface material varies from a fine sand to loamy fine sand, with occasionally a layer, 2 or 3 inches thick, of fine sandy loam between the soil and subsoil. The subsoil consists of a plastic clay, usually more or less sandy, but occasionally containing little sand. The color is bluish drab, becoming lighter with depth and mottled with

different shades of yellow and brown. This mottling usually increases somewhat with depth, but drab is always the predominating color. On the high hammock areas there are found small patches that contain considerable quantities of sandstone fragments of brownish color. There are also some spongy or porous fragments apparently representing partially weathered calcareous sandstone from which the calcareous matter has been dissolved. The fragments vary in size from small pieces to blocks several inches in diameter. On the low hammocks, as well as upon the high hammocks, there are also occasional outcrops of the underlying rock.

The Fellowship fine sandy loam is found in a number of areas scattered through the fine-textured soils. It occurs in the high hammock section west of Martel and in areas along the Withlacoochee River. Like the Fellowship sandy loam, it is found in both low and high hammock areas. The low hammocks are associated with the swamps and are very little above them, and in these situations the type is of semiswampy character, at times of heavy rainfall being covered with water. As it has a close, compact subsoil, the type drains slowly and is generally in a wet condition. On the other hand, the soil is found on high hammocks, representing low hills, attaining elevations up to 150 feet. The lower limit of these areas, where they merge into the surrounding sandy lands, averages about 90 feet above sea level. The slopes are long and smooth, though somewhat dissected by gullies or ravines. The high hammock areas have good surface drainage. However, the subsoil is close and impervious and much of the land is kept wet by seepage.

The material is largely of residual origin, derived from the weathering of rock probably consisting of limestone and sandstone.

The low hammock areas support a hardwood growth consisting of live oaks and water oaks of large size, with hickory, magnolia, and some other trees. The higher land is mostly forested with longleaf pine and with sweet gum in the open places. The ravines in the high hammock areas have a hardwood growth, and originally all these higher lands supported a hardwood growth. The pine trees here stand thick and grow very tall.

The low hammock lands are not in cultivation. In the past there were some orange groves on them, but since the freeze of 1894-95 they have been abandoned. Areas in the high hammocks are cleared and cultivated to the general farm crops. Average yields are obtained. Corn and oats do the best. Broom sedge takes the old fields. Some of the land was in orange groves, but these were abandoned after the freeze and the land allowed to revert to forest, the growth now consisting mainly of second-growth longleaf pine and some shortleaf pine.

The average results of mechanical analyses of samples of the soil and subsoil are given in the accompanying table:

Mechanical analyses of Fellowship fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
260841, 260843, 260845, 260847.....	Soil.....	<i>Per cent.</i> 0.4	<i>Per cent.</i> 5.2	<i>Per cent.</i> 12.9	<i>Per cent.</i> 52.7	<i>Per cent.</i> 18.9	<i>Per cent.</i> 5.4	<i>Per cent.</i> 4.5
260842, 260844, 260846, 260848.....	Subsoil..	.2	3.1	8.2	35.4	14.6	4.1	34.1

FELLOWSHIP CLAY.

The surface soil of the Fellowship clay consists of not more than 4 or 5 inches of sand, loamy sand, or sandy loam of black color in the immediate surface, and brownish gray beneath. In many places the surface soil is quite mucky. Over much of the type the clay comes to the surface, and even where present the sandy mantle is so shallow that when plowed enough clay would be brought up to make the land a clayey soil. The subsoil consists of a heavy clay, stiff, close-structured, more or less plastic, and of a "gumbo" or sticky character, even where sandy. It also has a somewhat greasy feel. The color is usually bluish drab, mottled with streaks of different shades of yellow and brown and to some extent with red. Usually the mottling increases with depth and the red becomes more conspicuous, but the drab color predominates throughout.

Only one area of this type was mapped. This is found northeast of Silver Springs on a low hammock extending out of the area on the northern boundary. It is low and flat and in large part semi-swampy, and during wet spells it is likely to be covered for some time with standing water. Owing to its heavy vegetation and the close structure and low-lying position of the subsoil it drains slowly. The tree growth is large, consisting of live oak, water oak, white oak, and possibly other varieties of oak, hickory, magnolia, cabbage palmetto, and some other trees, including a scattering of longleaf and shortleaf pines. Depressed areas support some cypress. The large cabbage palmetto is particularly conspicuous in this forest growth. Broom sedge makes a heavy growth, as do some other grasses and sedges.

The soil is residual, but the exact character of the parent rocks could not be ascertained. It is probable that the material is from rotten limestone and sandstone or arenaceous limestone.

None of this soil type is cleared. In its present undrained condition its value lies mainly in its forest growth, which at present is being removed and used by veneering mills in the manufacture of

shipping crates. It also forms good range land for stock, especially hogs, because of the large quantity of mast from the oaks.

In order that this land may be cultivated it will be necessary to drain it thoroughly, and whether this can be done economically is a question for decision by a competent engineer. If drained, it would no doubt be a strong, productive soil. Cabbage, oats, and grass crops should succeed. On a closely related soil with a somewhat deeper sandy mantle Johnson grass makes large yields. Owing to its heavy tree growth, the type is difficult and expensive to clear. In its present condition it is valued at about \$15 an acre, but at this price there is little on the market.

Results of mechanical analyses of samples of the soil and subsoil of this type are given below:

Mechanical analyses of Fellowship 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.	<i>Per cent.</i>
260835.....	Soil.....	0.3	7.5	13.4	34.8	15.9	16.4	11.8
260836.....	Subsoil.....	.5	3.3	7.3	15.9	7.4	11.3	54.3

FELLOWSHIP SAND.

The surface soil of the Fellowship sand to an average depth of 8 inches varies from a black to brown loamy sand to a brownish-gray medium sand. The subsoil to a depth of 3 feet or more continues as a dark to light-drab colored medium sand, the upper portion being slightly brownish in places. The color becomes lighter with depth and frequently the lower subsoil is somewhat sticky, containing some clay. Occasionally sandy clay is reached at 3 feet, but as a rule the depth to clay is 4 to 5 feet. This underlying clay is similar to that under the Fellowship sandy loam, being a drab-colored sandy clay, slightly mottled with yellow and brown. The lower subsoil is usually saturated with water, the underlying clay being somewhat impervious.

The Fellowship sand is of small extent, being limited to a few small areas on the higher hills south of Ocala and in the vicinity of Fellowship Church. These areas are flat and do not extend down the slopes to any extent. While they lie high, they are not thoroughly drained, because of the impervious clays beneath.

The origin of this type is not definitely known, but it is probably largely residual and derived mainly from the sandy formations associated with the Vicksburg limestones.

The Fellowship sand supports both a hardwood and a pine growth. The former consists mainly of different varieties of oak and mag-

nolia. There are also some cabbage palmetto. Both the longleaf and shortleaf pine are found upon it.

Some of this soil type is cleared, but it is considered rather poor, giving only moderate yields of the different farm crops. Broom sedge and wire grass grow upon it, the better drained portions supporting a good sod of wire grass.

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

Mechanical analyses of Fellowship 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.	<i>Per cent.</i>
260837, 260863	Soil.....	0.8	8.1	19.4	53.8	13.0	3.0	1.9
260838, 260864	Subsoil.....	.4	7.5	18.9	54.1	14.2	3.0	2.0

PARKWOOD CLAY LOAM.

The surface soil of the Parkwood clay loam ranges from 4 to 8 inches in depth, averaging about 6 inches. It consists of a friable clay loam, generally quite silty, but in places, especially bordering sandy lands, there may be a shallow covering of sandy material, not more than an inch or two thick. There is some variation in the color of the soil. In the wooded areas and in low spots the color is black and the immediate surface is more or less mucky, but in the cultivated fields the soil becomes brown to grayish. In the Warm Spring hammock the brown color predominates, while in the other areas the color is black to grayish. The immediate subsoil consists of a dark-yellow or light yellowish-brown clay or silty clay. This becomes lighter, almost white to ochreous yellow, with increase in depth. In higher spots in the Warm Spring hammock the upper subsoil is for a few inches a dark or rusty-red clay. The thickness of the yellow portion of the subsoil varies from an inch or two to 2 feet, but it usually occupies 6 to 15 inches of the profile section. The lower part of the subsoil either contains a noticeable amount of yellowish-white to white marl or rotten limestone material, or consists largely of white clayey marl or weathered limestone material. Quite often this marly material is near enough the surface to be reached by the plow. In such places fragments of the material are scattered over the surface and intermingled with the soil material. Throughout the type there are occasional small stony areas in which the fragments consist of flintlike limestone. These are irregular in shape and range in size from small pieces to blocks a foot or more in diameter. This limestone, before it is exposed, is very soft, but upon exposure to the air becomes very hard.

The Parkwood clay loam occurs in the southeastern part of the area, in the vicinity of Panasoffkee Lake. It is of comparatively small extent, being limited to a few small areas. The largest of these are the Warm Spring hammock, just southeast of the corporation limits of the town of Coleman, and a somewhat larger area southwest of Wildwood, in which the Monarch orange grove is located. The other areas are small spots occurring as islands in the extensive swamps of this section.

This type occupies low-lying, flat areas. All of these, with the exception of the Warm Spring hammock, occur in the swamps occupying slightly elevated islandlike situations, indicated by their hammock growth of hardwood trees in contradistinction from the swampy growth of cypress. Owing to their low-lying position they are poorly drained. The Warm Spring hammock, however, owing to its higher position and nearness to Warm Spring Run, as well as its somewhat porous substratum, has fairly good drainage. The area near Wildwood lies low, and in putting out citrus trees they are planted on mounds in order to get better drainage.

The Parkwood clay loam is residual, being derived from limestone and deposits of marl or a soft marl-like limestone.

The Parkwood clay loam is considered the best and strongest soil in the area surveyed. It is well suited to a large number of crops—that is, where it can be drained sufficiently. At Coleman it is used mainly for cabbage and tomatoes, and these products have made a reputation on the markets for their good quality. The cabbage yield ranges from 200 to 450 crates to the acre, averaging about 110 pounds to the crate. From 1,200 to 1,500 pounds of high-grade fertilizer analyzing about 5 per cent of phosphoric acid, 6 per cent of nitrogen, and 8 per cent of potash is used. It is a cottonseed meal, blood, and bone mixture, with acid phosphate and potash. The same fertilizer is used for tomatoes, the quantity generally being about 1,000 pounds to the acre, and the yield of tomatoes ranges from 250 to 300 crates. The tomatoes are said to be of first quality. They are sound and heavy, and on the average are said to bring 50 cents more per crate than tomatoes from other soils. Cabbage and tomatoes are often grown year after year on the same land, but there is in reality a rotation of crops, for the truck crops are always followed by corn, which yields, without further application of fertilizers, 50 bushels per acre. After the corn is harvested crab grass, crowfoot, and sandspur volunteer and good yields of hay are obtained. Beggarweed, when it has obtained a hold, crowds the grasses out, but it gives a heavy yield of hay and in addition is a valuable soil improver, for, being a legume, it adds to the store of nitrogen. In September, after the hay is harvested, the land is plowed again and prepared for either cabbage or tomatoes.

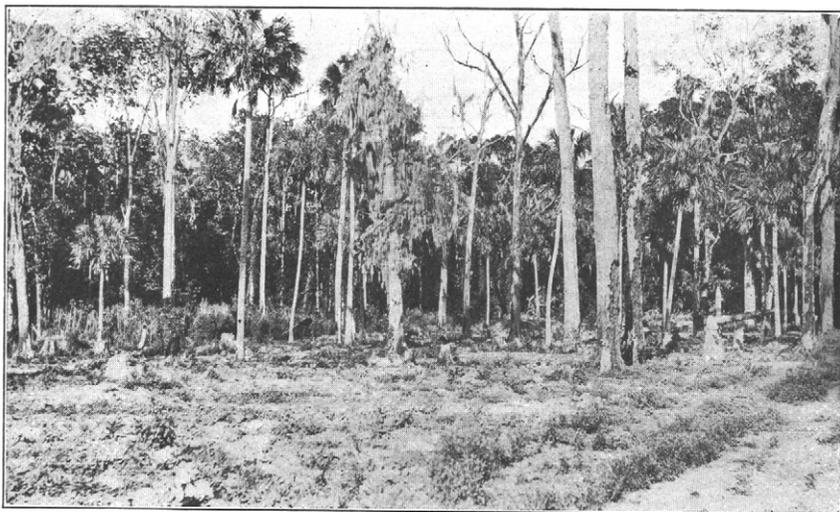


FIG. 1.—TYPICAL "HAMMOCK" GROWTH OF CABBAGE PALMETTO, AND OAK AND OTHER HARDWOODS, ON PARKWOOD CLAY LOAM NEAR COLEMAN.

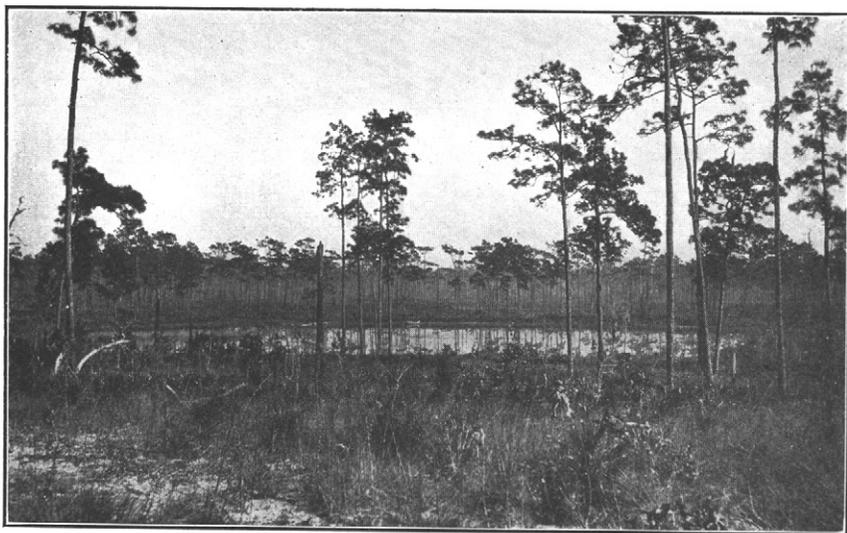


FIG. 2.—"GALLBERRY FLATWOODS" ON LEON SAND NEAR WILDWOOD.

[Longleaf pine, scrub palmetto, and gallberry bushes constitute the principal growth on this poorly drained type of soil. The shallow pond in the foreground dries up in dry seasons.]

Beets also do well and are grown to some extent upon this soil. Onions, while grown only in small patches, yield heavily. Those areas of this soil having a rather mucky surface are especially adapted to onion growing. In the Warm Spring hammock there are about 50 acres under irrigation. The overhead system known as the Skinner system is used. (Pl. I, fig. 1.) While this soil, where elevated at all, because of its porous nature can absorb much water during wet seasons without becoming excessively moist, it also resists drought well. In dry seasons, however, it is found that the crops can be hastened and the yield greatly increased by irrigation.

The hammocks southwest of Wildwood and those along Lake Panasoffkee are devoted entirely to citrus fruit growing. That near Wildwood is the site of the Monarch orange grove, which is said to be one of the largest in the world, containing over 500 acres in one tract. Other areas of the Parkwood clay loam also support large groves. The trees in these groves do not receive any fertilization whatever, the soil being strong enough to produce thrifty trees and sound fruit. As these hammocks are low and adjoin swamps, the trees, as already stated, are planted upon mounds, so that they may stand above water during wet seasons. The oranges, grapefruit, and tangerines produced in these groves are of the best quality. The trees are young, however, the freezes of 1894-95 and 1899 having completely destroyed the groves, so that while a large output is obtained at present, the production, provided unfavorable seasons do not occur, will be greatly increased as the trees grow older and larger.

The Parkwood clay loam supports a heavy growth of large trees with a thick undergrowth, forming in the undisturbed forests an almost impenetrable jungle. Live oak, water oak, and white oak, hickory, magnolia, sweet gum, black gum, ash, with some cabbage palmetto and large slash pine constitute the principal tree growth. (Pl. II, fig. 1.)

The orange-grove properties are not on the market, and the hammock land at Coleman is worth \$250 to \$300 an acre, being the most valuable land in the area surveyed. There is rarely any change of owners, however, as the land is so desirable because of the profit to be derived from it that only under extraordinary circumstances is it disposed of. The value has increased 400 or 500 per cent in the last 10 years.

The individual holdings are small, the hammock being divided into 10-acre tracts and very few having more than this acreage. The whole area of a tract is devoted to the crops, the owners living on the sandy lands at Coleman, where the location is more healthful and the land has little agricultural value.

The mechanical analyses of typical samples of the soil, subsoil, and lower subsoil of the Parkwood clay loam are given in the following table:

Mechanical analyses of Parkwood clay 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.	<i>Per cent.</i>
260825, 260828	Soil.....	0.6	3.4	6.5	24.9	9.8	30.2	24.6
260826, 260829	Subsoil.....	2.8	6.0	6.7	22.6	8.6	26.3	27.2
260827, 260830	Lower subsoil...	2.1	5.2	4.5	13.1	6.1	40.9	27.9

The following samples contained more than one-half of 1 per cent calcium carbonate (CaCO_3): No. 260825, 25.52 per cent; No. 260828, 5.97 per cent; No. 260829, 11.84 per cent; No. 260827, 60.95 per cent; No. 260830, 48.63 per cent.

PARKWOOD FINE SANDY LOAM.

The surface soil of the Parkwood fine sandy loam varies considerably in depth, ranging from about 6 inches to 2 feet. It varies from a light fine sandy loam to a loamy fine sand, the immediate surface usually being black and somewhat mucky, especially in wooded areas, and the subsurface dark gray to gray. The subsoil begins as a plastic yellow silty clay, containing some marl and weathered limestone material, and grades into gray or nearly white marly clay, the content of calcareous material increasing downward. There is a variation in which the surface soil is black down to the clay subsoil and contains considerable numbers of small fresh-water shells, such areas being locally known as "shell hammocks."

The Parkwood fine sandy loam is of small extent, being limited to a number of small areas in Sumter and Citrus Counties, in the region of Panasoffkee Lake and Withlacoochee River. The areas occur partly surrounding the Warm Spring hammock and on the borders of swamps and small islands in the swamps. They are low lying, flat, and barely elevated above the swamp; hence are poorly drained. The exceptions are those areas occurring along the Withlacoochee River banks, which have good drainage.

It appears that the sandy surface soil of this type consists of sedimentary material originally unconsolidated. The subsoil is unquestionably residual from marl and limestone.

The greater part of the Parkwood fine sandy loam is cleared and under cultivation. Around the hammock at Coleman the same trucking crops that are grown on the Parkwood clay loam are grown, namely, cabbage and tomatoes, but being less productive it is not so much in favor. It has a wider crop adaptation, however. Irish potatoes and other truck crops, as well as the general farm crops,

yield exceptionally well upon it. Around Lake Panasoffkee citrus fruits are grown, and, as on the Parkwood clay loam, no applications of commercial fertilizers are made.

This soil supports a hammock growth similar to that of the Parkwood clay loam, with pines encroaching upon it where it grades into the adjoining sandy lands.

The value of this land is high and it brings about as much as the Parkwood clay loam in the Warm Spring hammock. The areas around Lake Panasoffkee that are not in orange groves are less valuable because of their distance from railroads.

The average results of mechanical analyses of samples of the soil and subsoil of the Parkwood fine sandy loam are shown in the following table:

Mechanical analyses of Parkwood 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.	<i>Per cent.</i>
260833, 260851.	Soil.....	0.1	6.0	20.7	53.5	11.6	5.6	2.4
260834, 260852.	Subsoil.....	.2	4.3	16.9	40.6	9.1	9.3	19.4

The following samples contained more than one-half of 1 per cent calcium carbonate (CaCO_3): No. 260834, 16.09 per cent; No. 260852, 12.68 per cent.

LEON SAND.

The Leon sand is the typical soil of the scrub palmetto flatwoods, though it includes a hammock phase when considered from the standpoint of vegetation. The texture and structure of the soil material are identical in the scrub and hammock areas. It also occurs in the sand ponds or depressed basins. Typically the soil consists of gray to white medium sand, somewhat compact but incoherent where cultivated, 36 inches or more in depth. The gray color of the surface is the result of a slight admixture of organic matter. In places along the contact with Portsmouth soils the surface is often dark. A characteristic feature of the type is the speckled or salt-and-pepper appearance of the surface, caused by specks of organic matter intermingled with the soil grains and, to some extent, the staining of the soil grains themselves with organic material. Beneath the gray or grayish-white surface the sand is generally white, though in places a slightly yellowish or brownish tinge is found. There is usually encountered within the soil profile of 36 inches, as a rule from about 20 to 30 inches beneath the surface, a brown-colored compact stratum of sand. This material resembles coffee grounds. It is darker in the upper portion, gradually becoming lighter below. Underneath is found water-saturated white or slightly drab-colored medium sand,

extending to the underlying limestones of the region. The thickness of this compact brown layer varies from a few inches to a foot or more. This layer is locally known as "hardpan." When wet it is penetrated without difficulty by the soil auger, but when dry it becomes hard, and, at least in places, will obstruct the growth of the roots of plants and trees. The brownish material giving rise to the compactness of the layer consists of organic matter, with some compounds of iron. Observation discloses the fact that it is formed at or under the permanent water-table level.

The Leon sand is found in the eastern half of the area, where it occupies the flat situation known as "scrub palmetto flatwoods." The tree growth is mainly longleaf pine and in places shortleaf pine, the trees being generally stunted and sparse. Its characteristic undergrowth is scrub saw palmetto, with some gallberry bushes, grasses, and sedges. (Pl. II, fig. 2.) These flats occur along the larger streams and lakes. One area lies in the vicinity of Silver Springs Run, but the largest development of this phase is in the Withlacoochee Valley, east of the river and around Lake Panasoffkee, in the vicinity of Coleman. The elevation of these flats is 50 to 60 feet above sea level. While generally flat, they occasionally show some slight undulation, caused by trough depressions or depressed basins and by sink-hole ponds. Here and there, especially in the southern part of the area, some rock outcrops are found, consisting of the flinty part of the underlying limestones.

There is some variation in the type where it occurs in the hammocks, the soil being darker than in the flatwood areas, owing to a greater proportion of organic matter. Also, the hardpan substratum is of less frequent occurrence, being found only in small spots and is deeper or entirely absent in the soil profile. In some places the material lies directly upon rock. The tree growth on these hammocks consists of live oak and water oak, magnolia, cabbage palmetto, and some other hardwoods. The largest hammock areas are found in basins in the "high hammock" land, which are spoken of as "sand scrub." The tree growth here is large, owing in part either to nearness of the underlying clays or to the good moisture conditions. Flinty rock outcrops are frequent. Some hammock growth is also found forming rims around ponds in the pine-woods areas.

A phase of this type occurs in the ponds and prairies shown on the topographic base as intermittently wet areas and locally called "sand ponds." The sand mantle here is gray or dark gray and is underlain at a few inches by a brown "hardpan layer." These ponds are very leachy, holding water only a short time. Dog fennel is the principal growth. These depressions occur in the flatwoods area and in the basins in the rolling sandy lands. The material constituting this

soil undoubtedly is derived directly from originally unconsolidated Coastal Plain deposits.

The Leon sand is generally recognized as a very poor and undesirable soil. The hardpan stratum seems to prevent or check the movement of water either down or up. During rainy spells the water is held in the upper portion, and as the land lies low it is very often covered with water. This water can escape by lateral seepage and by evaporation, only the latter being probably the most effective means of removal. On the other hand, when the dry season comes, which is in the winter and early spring, the soil becomes very dry and will not support growing crops. This hardpan stratum, however, in some of the developed trucking sections of the State, is said to constitute a valuable feature, in that it tends to hold up irrigation water in such a way as to make the artificial application of water cheaper and more effective. Heavy applications of nitrogenous, phosphatic, and potassic fertilizers have to be made in order to produce good yields. Organic matter should be supplied by adding barnyard manure, where obtainable, or by turning under some leguminous crop, such as cowpeas, velvet beans, or beggarweed. With the incorporation of sufficient quantities of organic matter and commercial fertilizers this soil can be made to produce a number of trucking crops, such as lettuce, celery, and potatoes. On some of the better Leon sand outside of this area cucumbers are grown with profit. None of the type is cleared and under cultivation within this area. It has a very low value.

LEON FINE SAND.

The Leon fine sand is similar in all respects to the Leon sand, with the exception that the texture is fine instead of medium. It occurs in association with fine-textured soils in the western half of the area. The type consists of fine sand to a depth of 36 inches. The surface portion is gray to almost white, and the subsoil almost white, except for a brown layer of "hardpan" which is usually present somewhere in the 3-foot section. Beneath the hardpan is found white or slightly drab-colored sand saturated with water. Like the Leon sand, the material is somewhat compact in place, but upon handling it becomes incoherent. The texture is uniform throughout the 3-foot section, but there is slight variation in texture from place to place as it tends either toward a coarser or a finer texture. In places along the border with Swamp or the Portsmouth soils it is considerably darker here, approaching the character of the Portsmouth soils.

The Leon fine sand occupies extensive areas of palmetto flatwoods along the Withlacoochee River and in the Lake Tsala Apopka section. In the latter development it occupies flats standing only slightly above the waters of the lake or which extend into the shallow parts

of the lake and are covered by water only during the wet season. In the Tsala Apopka Lake section there are also areas supporting a hammock growth of water oak and live oak, magnolia, and other hardwood trees and shrubs. The flatwoods support a thick growth of scrub saw palmetto, with some gallberry on the poorly drained spots, and broom sedge and wire grass on the better drained areas. The tree growth consists of shortleaf pine having a stunted appearance and frequently gnarly and twisted tops. There is a considerable area of this soil in the shallow ponds and prairies which hold water only during wet periods, at other times being entirely dry, and which support a characteristic growth of dog fennel, with some grasses and sedges. These areas are indicated by symbol.

The Leon fine sand is considered a poor and undesirable soil. It is too wet during rainy seasons and too dry in dry seasons. Because of the finer texture of this soil it is a somewhat better soil than the Leon sand.

To insure success with crops on this land, irrigation is necessary, and with the methods of subirrigation in vogue in some parts of the State¹ by the use of tiles, which bring a supply of water as required and at other times afford drainage, agriculture, especially the production of special crops, could be made profitable. In addition to irrigation and drainage, however, success would depend upon the incorporation of a good supply of organic matter in the soil and the liberal use of complete commercial fertilizer or barnyard manure. A great variety of crops could be produced. Lettuce and celery are grown on similar soil in other sections of the State, also cucumbers, strawberries, and some other special crops. A little of the land is cleared and cultivated to the general farm crops, but the yields are low. There are areas along the Withlacoochee River that could be drained readily and irrigated, though probably artesian water could not be obtained. At present most of this soil is too far from the railroads to make the growing of special crops practicable and its value is very low.

PORTSMOUTH SAND.

The surface soil of the Portsmouth sand consists of 8 to 18 inches of a black, loamy sand, high in organic matter, having in places almost the characteristics of muck. This changes abruptly into a drab or drabbish-gray to white sand, 36 inches or more in depth. In places a layer of brown sand, resembling coffee grounds, is encountered at varying depths. This layer represents the "hardpan" stratum so common in Florida soils. The subsoil is always in a water-soaked condition. The sand is rather compact in its natural

¹ See Circular No. 21, Bureau of Soils. This circular discusses briefly the uses and value of subirrigation in the trucking section about Sanford, Fla.

position, but is incoherent when disturbed, and, like the subsoil of the Portsmouth fine sand, tends to flow when dug into in a way resembling a quicksand.

The areal extent of the Portsmouth sand is small compared with that of other types. It occurs in small areas scattered throughout the eastern part of the area, associated with the other soils of medium texture, being confined to depressed situations in the flatwoods; to sink-hole or basin depressions in the higher lands; and to the lakes and prairies of the area. These areas are all wet a large part, if not all, of the year. This condition favors the accumulation of organic matter on the surface, and is in contrast with other ponds or depressions, known as "sand ponds" that do not hold water long, and thus do not afford conditions favorable for the accumulation of organic matter.

The Portsmouth sand is derived from unconsolidated sedimentary Coastal Plain deposits. The dark-colored organic matter represents simply the decomposing remains of vegetation.

As this soil lies so that it is wet much of the time, and lacks drainage, it affords very little land for cultivation. Much of it would be difficult or impossible to drain economically. There are, however, some small areas in cultivation. Where it can be drained, either by ditches or tiles, fairly good results with certain vegetables may be expected. This same soil in developed sections of the State is successfully used for crops like celery, lettuce, cucumbers, and strawberries, but only a few small areas have been utilized in this survey. Those areas where drainage is practicable would warrant being put in condition for cultivation. This soil, wherever it occurs, is found to be sour or acid, and liming is necessary before it can be made to produce crops that do not thrive in acid soils. Under cultivation this soil, especially where given clean cultivation, soon loses much of its organic matter by oxidation. Thus it is advisable to keep it in some cover crop, or allow the weeds to grow. Barnyard manure is beneficial to this soil, and for producing the special trucking crops fertilizers are necessary. Because of its poor drainage and lack of development, this soil has a low value.

The natural vegetation varies. In ponds and prairies the grasses thrive, including saw grass, sword grass, broom sedge and other sedges, and aquatic plants. There is plenty of forage produced, so that these lands are held in some esteem as pasture. Some of the areas support a growth of cypress, with other hardwood trees in the less swampy places.

PORTSMOUTH FINE SAND.

The surface soil of the Portsmouth fine sand to a depth of 10 to 15 inches consists of a black loamy fine sand to mucky fine sand, high

in organic matter. This is underlain by compact drab or gray water-soaked fine sand. When bored into, the sand runs into the auger holes, showing that the subsoil flows on the order of quicksand when exposed. This tendency makes it difficult to dig effective ditches. In places there is found the brown "hardpan" layer of fine sand like that of the Portsmouth sand. The type grades into the Leon soils on the higher positions in such a way that sharp boundaries could not always be drawn.

The Portsmouth fine sand has a considerable development in the area, being found in a number of bodies along the Withlacoochee River and the Tsala Apopka Lake section. It is also found in small areas in the shallow lakes or prairies occurring in the Norfolk fine sand in the western part of the area.

The Portsmouth fine sand is a low-lying soil, occurring in association with the swamp and lakes. It is flat and poorly drained. The water table is near the surface, and the subsoil is always saturated. The surface is frequently covered by water during rainy spells. Some bodies of this type occur in swampy areas, while a good deal of it is found in the shallow lakes or prairies and ponds or sinks. An area east of Dunnellon occupies a flatwoods section that is dotted with numerous shallow grass ponds or prairies.

The Portsmouth sand supports a variety of vegetation in its different areas. In the ponds or prairies are found water-loving grasses and sedges. Saw grass, sword grass, water lilies, and some other aquatic plants flourish in the shallow water-covered areas. The less frequently water-covered treeless areas support a heavy growth of broom sedge, as well as other sedges and grasses. There are some bodies that have a growth of water-loving trees, such as cypress, gum, magnolia, bay, cabbage palmetto, and others. In its lower-lying positions it also occupies flatwoods areas, which are distinguished by the sparse and rather low growth of longleaf and shortleaf pine and an undergrowth of gallberry bushes. The scrub palmetto also occurs, but is not prominent except on the higher parts. This latter growth is more characteristic of the associated Leon soils. Besides gallberry, broom sedge flourishes, as well as some other grasses and sedges. Areas of the type where the pine is removed are commonly referred to as "gallberry flats" and "flatwoods."

Largely because of its low-lying position and poor drainage, none of the Portsmouth fine sand is cleared and under cultivation. The depressed areas in ponds and along swamps would be difficult, if not impossible, to drain. The flatwoods areas, while being only slightly above the depressed areas, might possibly be drained. This type of soil, thoroughly drained, would prove valuable for a variety of crops, not only general farm crops, but truck crops. For the latter it is especially well adapted. It is upon this class of soil that much of

the trucking is done in the State. Celery, lettuce, onions, strawberries, cucumbers, and some other crops would do well. In addition to being drained, this land would require irrigation to insure success, as vegetable growing is done during the dry season. Where drainage is practicable it would certainly be advisable to develop the agricultural possibilities of this soil type. Rather liberal applications of complete fertilizer mixtures would be necessary for good yields. Liming would also prove beneficial.

The present value of this land is low, and there is no demand for it on the market.

SWAMP.

Swamp includes those low-lying areas that are more or less covered by water throughout the year and support a growth of water-loving trees. These are mainly cypress, but gums and other species are found. In hammocks in the Swamp magnolia, bay, hickory, and cedar are found, but in the larger and wetter swamps cypress is almost the only growth, many of the trees being of great size. The extent of Swamp is considerable, the largest areas being along the Withlacoochee River and around Lake Panasoffkee. There is also an area bordering Silver Springs Run and connecting with the Dead River Swamp, on the northeast boundary of the area.

The Swamp is the lowest-lying land in the area. The elevation lies between 40 and 50 feet above sea level. The Swamp owes its occurrence to the sinking of the land resulting from the solution of limestone.

Drainage over most of the type would be very difficult and expensive, if not impossible. When the streams are at the high-water stage the swamps are covered by water, but during dry seasons the immediate surface may be entirely dry.

The soil of the Swamp varies considerably, as might be expected. As a general rule, however, the surface is mucky to some depth. In places the underlying clays are found near the surface. They are of drab or bluish to dark color and often mottled, ranging from stiff plastic clay to heavy sandy clay. In places a compact white or drab sand is encountered beneath the mucky surface material.

Swamp, marl subsoil phase.—A part of the Swamp is underlain by marl. Around Lake Panasoffkee the profile consists of muck underlain by shell marl, and some of the Swamp along Silver Springs Run is of the the same character, though no attempt was made to differentiate such areas in the latter section. Low hammocks of marly character in the Swamp along Withlacoochee River support a growth of cedar and are known as cedar hammocks.

The mineral soil material of the Swamp, particularly the clay, is in part residual from limestone, marl, and shell beds. Deposits from

the stream flood waters have been added. The mucky surface is from the partial decay of the heavy vegetation growing in the swamps.

The cypress trees constitute the main value of the Swamp, but during the dry season the land affords good range for hogs. It has no present agricultural value.

SUMMARY.

The Ocala area is situated in the north-central part of the Florida peninsula and comprises an area of 1,002 square miles, or 641,280 acres. It includes parts of the counties of Marion, Sumter, Citrus, and Levy. It forms an elevated portion of the peninsula and is underlain by limestone.

The topography is varied, ranging from low and flat areas in the swamps and flatwoods to rolling in the sandy hills and high hammocks. The highest point in the area is 220 feet and the lowest 20 feet above sea level. A marked feature of the topography is the sinkholes and depressed areas and the general lack of surface drainage systems, the drainage waters passing downward through the porous soils.

The area drains into both the Gulf of Mexico and the Atlantic Ocean. The Withlacoochee River passes through the area in its central part, flowing northwest and emptying into the Gulf. On the northeast the Silver Springs rise from subterranean channels and flow east to the Ocklawaha River, emptying into the St. Johns River, which in turn empties into the Atlantic Ocean.

Settlement began prior to 1850, but the extension of settlement has been slow, and the rural population is still sparse. The early settlers were from Georgia and North and South Carolina. In recent years numbers of settlers have come from the Northern and Western States.

The railroad facilities are exceptionally good, both the Atlantic Coast Line and Seaboard Air Line Railroads passing through the area. These are main trunk lines. In addition to these are the Ocala Northern and Ocala Southwestern Railroads. Water transportation is afforded by Silver Springs Run and the Ocklawaha and St. Johns Rivers. There is also local water transportation on a part of the Withlacoochee River and Panasoffkee Lake. The county roads are numerous. They are being rapidly improved, and there are many miles of stone and clay surfaced roads.

Ocala, the county seat of Marion County, with about 4,500 inhabitants, is the largest town. It is an important business and railroad center. Dunnellon, Hernando, and Inverness, in the western part of the area, are towns of considerable importance in the phosphate-mining section. Belleview, Summerfield, Oxford, Wildwood, and

Coleman are important towns in the eastern part of the area on the railroads. Their interests are agricultural.

The climate of the area is mild, approaching the subtropical. The mean annual temperature is 69° F. and the mean annual precipitation about 52 inches.

The early agriculture was restricted to the growing of the subsistence crops and sea-island cotton, along with stock raising. After the Civil War citrus-fruit growing was taken up, which industry was almost entirely abandoned when the trees were killed by the freeze of 1894-95. Since 1890 phosphate mining, turpentine, and lumbering have been important industries. Aside from these the agriculture, while not developed over the whole area, consists in the production of general field crops, truck crops, and citrus fruits. Corn, oats, sweet potatoes, sugar cane, and velvet beans are the principal general crops, while cabbage, tomatoes, watermelons, cantaloupes, and cucumbers are the trucking crops. With the exception of the growing of cabbage, the trucking industry is of recent growth. The production of citrus fruits in the southern part of the area is being revived to some extent.

Exclusive of Swamp, 17 types of soil, included in six series, were separated and mapped.

The Portsmouth and Leon soils, each having two types, a sand and a fine sand, are found in the low-lying flatwoods. The Portsmouth types are characterized by black surface soils and drab subsoils. They require drainage and are among the best trucking soils when reclaimed. The Leon soils form the palmetto flatwoods and consist of gray to white sand, with a brown hardpan layer beneath. Without irrigation they are very poor soils.

The Norfolk sand and fine sand types are the rolling pine lands of the area. They are the gray and yellowish sands over 36 inches in depth. For the most part they are held in low esteem, but the better parts of these types make fair trucking soils, especially with overhead irrigation. They are loose and have excessive drainage.

The hammock soils fall into three series—the Parkwood, Fellowship, and Gainesville. The Parkwood soils, consisting of the clay loam and the fine sandy loam, are found on low hammocks and have marl subsoils. They constitute the strongest soils of the area and grow cabbage and tomatoes to perfection. They are also highly esteemed for citrus-fruit production and the large groves in the area are on these soils.

The Fellowship soils occur on both low and high hammocks, the former being in part semiswampy. With drainage these are good soils. The high hammocks support a heavy pine growth. They are adapted to a wide range of crops, but so far there is not much development on them.

The Gainesville soils occur on the high hammocks and are largely of calcareous origin. They are all well-drained, productive soils. They produce all the general farm crops and also have a wide adaptation for truck crops. Trucking is being extensively developed on these soils, especially on the Gainesville loamy sand.

The climatic conditions in the area are such that the growing season is very long, some hardy crops being grown during the winter, with protection at times of frost. A succession of crops amounting to a rotation is thus permitted. Corn or cowpeas follow the trucking crops. After corn the volunteer growth of crab grass, crowfoot grass, sandspur, or beggarweed follow and are cut for hay.

Development of the agricultural resources of the area can be said hardly to have been begun. There is opportunity for profitable agriculture along all the lines discussed in this report.



[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved March 14, 1904.

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

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