



CYPRESS FOREST IN THE OKEFINOKEE SWAMP

GEOLOGICAL SURVEY OF GEORGIA

S. W. McGALLIE, State Geologist

DRAINAGE INVESTIGATIONS

OFFICE OF EXPERIMENT STATIONS, U. S. DEPARTMENT
OF AGRICULTURE

C. G. ELLIOTT, Chief of Drainage Investigations

BULLETIN NO. 25

A PRELIMINARY REPORT ON

DRAINAGE RECLAMATION

IN

GEORGIA

The Drainage Situation in Georgia

BY

S. W. McGallie, State Geologist

AND

Drainage Examinations and Surveys in
Georgia

By U. S. Department of Agriculture

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LETTER OF TRANSMITTAL

GEOLOGICAL SURVEY OF GEORGIA,

ATLANTA, June 15, 1911.

*To His Excellency, JOSEPH M. BROWN, Governor, and President of
the Advisory Board of the Geological Survey of Georgia.*

SIR: I have the honor to submit herewith a preliminary report on Drainage Reclamation in Georgia by this department and Drainage Examinations and Surveys in Georgia by the U. S. Department of Agriculture, to be published as Bulletin No. 25 of this Survey.

Very respectfully yours,

S. W. McCALLIE,

State Geologist.

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DRAINAGE CONDITIONS IN GEORGIA

SWAMP AND OVERFLOW LANDS

S. W. McCALLIE

INTRODUCTORY

With the exception of Florida, Georgia has the greatest area of swamp and overflow lands of any of the Atlantic seaboard states, from Maine to the Gulf of Mexico. The extent of Georgia's swamp lands, as given by Mr. C. G. Elliott, chief of Drainage Investigations, Office of Experiment Stations, U. S. Department of Agriculture, aggregates 2,700,000 acres, which is approximately one-fourteenth of the area of the entire state. The largest individual area of swamp land in the state, and one of the most extensive fresh water swamps in this country, is the Okefinokee Swamp, which comprises an area of about 500,000 acres. A large part of this swamp originally belonged to the state, but it was sold by an act of the legislature in 1890 to a private corporation for 26½ cents per acre. Some idea may be had of the extent of the state's swamp and overflow lands when it is stated that they exceed in area more than one-third of Holland, which country supports a population greater than twice Georgia's population, as shown by the census of 1910.

The swamp and overflow lands of Georgia may be divided, for convenience of description, into the following divisions: swamp lands, overflow lands, wet lands and salt-marsh lands.

SWAMP LANDS

The term swamp lands, as here used, embraces those lands that are covered with standing water throughout all, or a greater part, of the year, and in which water-loving plants generally grow in greater or

less profusion. Lands of this character are most often met with in the southern part of the state where the surface of the country is usually flat and the streams are sluggish and have but little fall. To this class of lands belong the innumerable small cypress swamps of South Georgia as well as the great Okefinokee Swamp with its hundreds of thousands of acres. Some of these swamps seem to owe their origin to original depression left by the water of the receding ocean, others are poorly drained, shallow valleys of erosion along the streams, and still others are irregular depressed areas caused by the solution of the underlying limestones. The various aspects of the swamps are dependent chiefly upon the character of the vegetation which they produce and this, in turn, is dependent, in a large measure, on the depth of the water. Where the water has a depth of only a few feet, often the bulk of the vegetation consists of aquatic plants, such as bog-mosses, water lilies, etc., which give to the swamp an appearance of a treeless prairie. In the shallow water such trees as the cypress often grow to large size, forming, with vines and undergrowth, a dense forest. Invariably, these swamp lands are covered to the depth of one or more feet with impure vegetable matter in the form of dark-colored muck or peaty material which would, no doubt, add considerably to the fertility of such lands in case they were properly drained.

OVERFLOW LANDS

Overflow lands are the low lands along streams which become covered with water during floods. They always form shallow valleys and are the direct result of stream erosion. Overflow lands are met with in all parts of the state, but are especially abundant in South Georgia where the geological conditions are exceptionally favorable for the formation of wide flood-plains. Streams, when swollen by heavy rainfall, spread out over their flood-plains and deposit mud and sand more or less mixed with vegetable matter, which usually form remarkable fertile soils. This class of lands in the state is undoubtedly increasing in extent, due, in part, to the

increasing frequency of floods brought about by cutting away the forests, but more largely due, perhaps, to the overloaded condition of the streams which causes the filling and the clogging of the channels by the accumulation of sands washed from unterraced upland fields. Another condition which has a tendency to augment the area of overflow lands, especially on small streams, is the accumulation of logs and drift-wood in the channels. In the last named instance the overflow conditions can often be effectually overcome by removing these obstructions, and by the cutting away of the cane, willows and other small growth which often rapidly encroach upon and obstruct waterways.

WET LANDS

Wet lands, as used in the above classification, include those lands which usually lie at a higher elevation than the swamp land, but are so poorly drained that during an excessively rainy season they produce little or no crops by reason of the excessive moisture of the soil. The uncertainty of crops from this class of lands is often too hazardous to warrant the expense of preparation and planting. During dry seasons they generally produce excellent crops, but should the growing season prove to be too wet the crop is often a complete failure. Wet lands are almost invariably level, the slope of the surface being insufficient to allow the water to escape by run-off. Furthermore, these lands are often underlain by impervious subsoil which retards, to some extent, the flow of the water by downward seepage. Wet lands are widely distributed throughout the state, but they are especially abundant near the coast and in the wire-grass section where the surface is nearly level and where there is but little variation in the topography. Such wet lands as here referred to are usually quite readily recognized by their growth of gallberry bushes, short-stemmed palmetto and stunted long-leaf pines.

SALT MARSH LANDS

Salt marsh lands are low mud flats and marsh grass lands along the coast between low and high tide. They are usually covered twice

daily by the tide and as a consequence they can only be reclaimed for agricultural purposes by the construction of dikes. These lands, built up, as they are, by fine silts and clays brought down by the inland streams, invariably carry ample plant food for the production of luxuriant crops. Salt marsh lands form many thousand acres fringing the sea islands and the adjacent main land from Savannah to St. Mary's.

INVESTIGATION OF DRAINAGE CONDITIONS BY THE STATE
INTRODUCTORY

As far as the writer has been able to ascertain, all of the drainage investigations by the state, so far, have been carried on by the State Geological Survey, with the exception of Col. R. L. Hunter's survey of the Okefinokee Swamp, made in 1856-7 during the administration of Governor H. V. Johnson, with a view of ascertaining the practicability of its drainage, the cost of the same, etc.

OKEFINOKEE SWAMP SURVEY

Dr. George Little, former State Geologist, in speaking of this survey and a subsequent survey of the swamp, says:¹

"The Hunter survey began on December 3, 1856, and ended April 3, 1857, and was conducted with the assistance of M. B. Grant and C. M. Forsyth, and cost \$3,260, including partial pay of the engineer in charge. There was furnished to the Governor a map of the swamp, with the elevation around the whole swamp and lines of ditches, which it was estimated would drain the swamp at a cost of \$1,067,250. This map was lost during the war, and it is only due to the enterprise of Colonel E. Y. Clarke, editor of *The Atlanta Constitution* that a copy of Colonel Hunter's report has been hunted up and preserved, which, with verbal information furnished by Colonel Hunter himself, has materially aided the preparation of a map of the swamp.

"On November 4, 1875, by direction of Governor J. M. Smith,

¹Dr. Little's report, as here given, was originally published in *Hand-book of Georgia* by T. P. Janes, Commissioner of Agriculture.

the party of the Geological Survey operating in Southern Georgia joined The 'Constitution Expedition,' organized by the proprietors of the paper of that name in Atlanta, and remained until December 14th. A line of levels was run by Mr. C. A. Locke, engineer of the 'survey,' from Mixon's Ferry on Suwanee River to Trader's Hill on St. Mary's, showing the following elevations referred to ebb tide:

	Feet
Trader's Hill, on St. Mary's River.....
Water surface at Mixon's Ferry.....	107.306
Bench B, in pocket.....	122.097
" D, " 	120.373
" F, " 	121.268
Swamp between pocket and Jones' Island.....	116.517
Jones' Island	121.401
Swamp between Jones' Island and Billy's Island.....	116.416
Billy's Island.....	118.009
Swamp E of Billy's Island.....	118.995
Camp Lee, Billy's Island.....	125.637
Billy's Lake, water surface.....	115.991
Swamp E of Billy's Island.....	118,995
Two miles from Billy's Island on Little Trail.....	119.326
Prairie West, side-water surface.....	121.241
Roddenberry's house, east side.....	153.351
Long Branch, two miles from Roddenberry's house.....	55.092
Trader's Hill.....	79.045
Water surface, St. Mary's River.....	5.000

"A map was prepared by Mr. M. T. Singleton, Assistant Engineer of the Geological Survey, which is here reproduced, showing the location of this line, as well as of other lines run by the compass and measured through the swamp by Mr. Locke and Mr. Pendleton, from Black Jack Island in the Southern portion to Honey Island south of Billy's Island; then to Billy's Island (called Pendleton's trail, from Mr. Charles Pendleton, of Valdosta, who accompanied the party); thence to Floyd's Island northeast; and thence northwest to Hickory Hammock, near the northern border, by Mr. Singleton and Mr. Loughridge, called Haines' trail, from Mr. George Haines, of Jesup, who furnished the laborers who cut out the way.

"The line of levels which was run around the whole swamp, and connected with the water in the St. Mary's River near Trader's Hill,

furnishes the following information in regard to the elevation of the surface at different points:

“The highest part of the swamp is its northern extremity, where it is 126½ feet above tidewater. Coming south, in six miles it descends five feet, and then in thirteen miles from the last point it descends only one and a half feet on the east side, it being at that point (Mr. Mattox’s) 120 feet above tidewater; while at an opposite point on the west side (the mouth of Surveyor’s Creek) it is only 116½ feet.

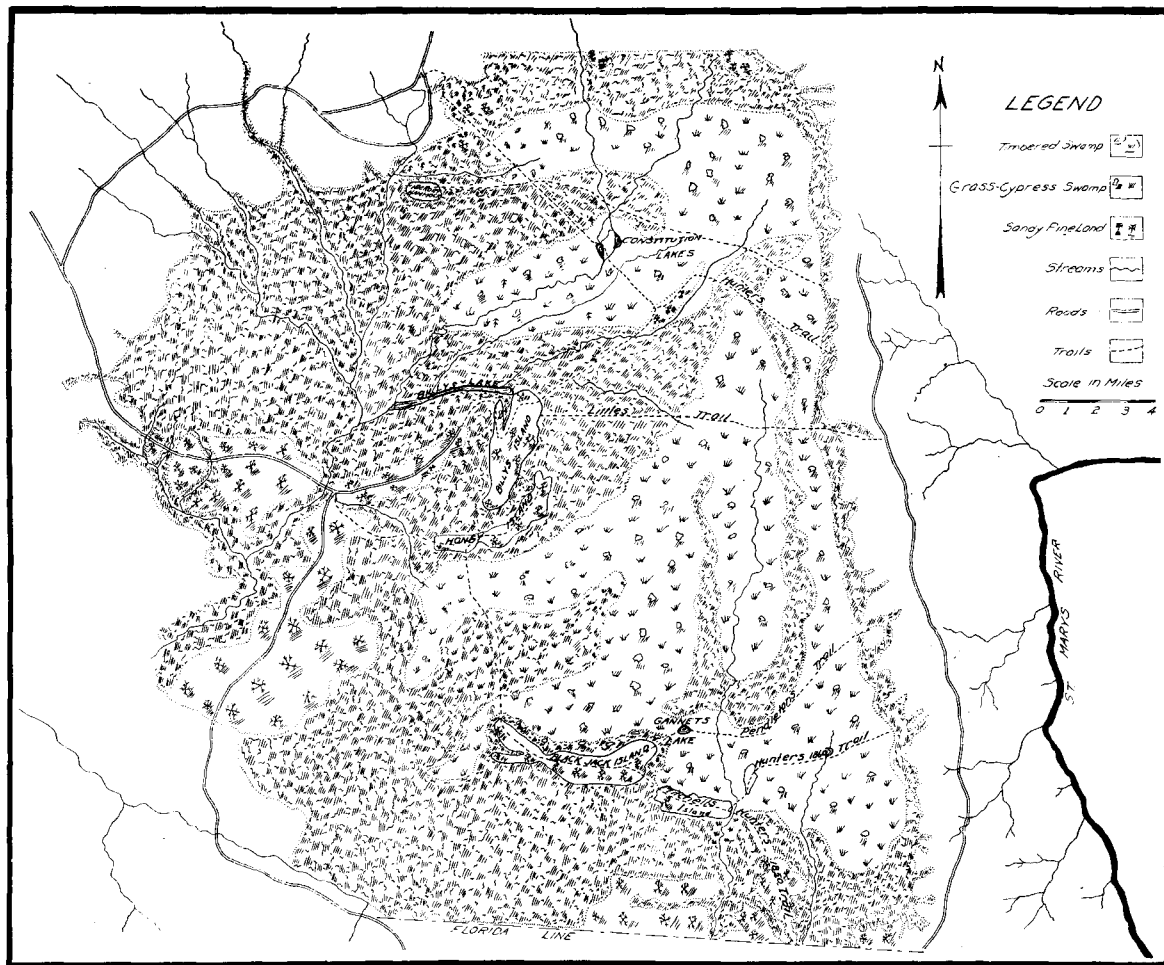
“A nearly uniform descent continues from Mr. Mattox’s to the southeast corner of the swamp, where the elevation is 116½ feet, while near Ellicott’s Mound, where the branch of the St. Mary’s runs out of the swamp, it is only 111½ feet.

“From the mouth of Surveyor’s Creek to the extreme western angle of the swamp, it falls scarcely any, but on turning eastward toward the Suwanee River it gradually descends, and where that stream comes out of the swamp it is only about 110½ feet above tide. At the northeast point of the Pocket it is 114½ feet. From that point it falls toward the place where Cypress Creek runs out, where it rises to 118½ feet when half way to the St. Mary’s and gradually falls again to it.”

In conclusion, Dr. Little says: “A partial survey shows that there would be no engineering difficulty in draining the whole swamp perfectly and rendering available the enormous amount of cypress timber as well as thousands of tons of muck, which, with the aid of the Satilla marls, would convert the sandy as well as the red clay lands in the border into market gardens.”

In addition to the surveys above given, Dr. Little makes the following notes on the general character of the swamp:

“A considerable area in the swamp bears cypress trees, which are nowhere excelled in size, one of which would yield thousands of shingles; and there is the pine and the white and red bays. The last of these take a fine polish, and would apparently be valuable for furniture and cabinet making. The islands in the swamp—Floyd’s,



MAP OF OKEFINOKEE SWAMP, BY M. T. SINGLETON, FORMER ASSISTANT STATE GEOLOGIST OF GEORGIA

Billy's, Honey and Black Jack—are covered with pine and palmetto on their higher portions, where the soil is white and sandy, but still produces a luxuriant growth of long, tender grass, on which deer and wild cattle keep fat the year round.

“On the borders of these islands there is a low hammock land which sustains a vigorous growth of magnolia, oak, etc., in a rich sandy soil. Outside of this are dense thickets of small shrubs, almost impenetrable, except where wildcats and bears have made their trails; and beyond these thickets, which sometimes give place to a perfect mat of bamboo briars ten feet high, many of them an inch in diameter and armed with thorns which stick like daggers, we find an open marsh filled with long rushes and water-lilies, whose thick roots afford the only support for the feet in wading through the soft ooze and mud, which yields to the weight of a man, so that he sinks to the arm pits in many places. Many small islands and clumps of trees dot these “prairies,” as they are called; and these are generally surrounded by a floor of moss, which is sometimes firm enough to hold one's weight, and again forms a floating surface over the water; and while it does not break through beneath the feet, one can see it sink and rise for 10 or 20 feet around at every step; hence its name—Oke-fi-no-kee, or Trembling Earth. The Casino, Holly, etc., are the principal trees. In some portions live oak is found on drier spots.

“In the prairies are many open holes, free from vegetation and several feet in depth; and in these are found alligators, sometimes 10 to 12 feet in length, while otters are more numerous along the streams which connect the main open prairies with Billy's Lake and the Suwanee River. This lake is about four miles in length, from 100 to 300 feet in width, and from four to eight feet in depth, perfectly clear (at the time of our visit in November) and abounding in the finest trout and jack fish, which even spring into the boat at night when a light is carried. In summer, hundreds of alligators may be seen sporting their unwieldy forms, while ducks and other water fowl are found in the greatest numbers. Just at

dusk, white herons may be seen settling in the trees on the banks of the small lakes, until they look like a solid white wall. Occasionally a goose is heard, uttering its melancholy croak as he flaps his broad wings just out of reach of the hunter's shot. A few squirrels are seen in the more open woods on the islands, while owls make the night hideous with their hooting. Some large moccasins are found in the morass."

In 1889, the Okefinokee Swamp, or that part of it owned by the state of Georgia, comprising an area of 380 square miles, was purchased by the Suwanee Canal Company at 26½ cents per acre. The object of this company in acquiring the swamp was, first, to utilize the timber which was known to exist therein in large quantities, and subsequently to drain the swamp and use the lands for agricultural purposes. With these objects in view, the canal company began, in September, 1891, the construction of a canal from St. Mary's River to the swamp, a distance of about six miles. Later this canal, which was 45 feet wide and six feet deep, was continued into the swamp for something like 12 miles. The canal was first to be utilized in getting the timber out of the swamp and thereafter it was to serve as the main drainage channel in draining the swamp. The Suwanee Canal Company, under the presidency of Captain Henry Jackson, of Atlanta, was successful in winning a large amount of cypress and other timber from the eastern side of the swamp, but operations were discontinued before the canal was sufficiently completed to have but little effect in draining the swamp as a whole. The large holdings of the Suwanee Canal Company have, within the last two or three years, been acquired by the Hebard Lumber Company, which is at present engaged in cutting and preparing for market the timber in the large cypress forest on the northwestern margin of the swamp.

For more complete information on the Okefinokee Swamp, the reader is referred to the following publications: William Bartram's *Travels*, published in 1791; *Georgia, Her Resources and Possibilities*, published by the Agricultural Department of Georgia in 1896,

and Okefinokee Swamp, by R. M. Harper, Popular Science Monthly, June, 1909.

SURVEY OF THE CHICKASAWHATCHEE CREEK SWAMP

Subsequent to the Little survey of the Okefinokee Swamp above referred to, no action was apparently taken by the State looking to the reclamation of the swamp lands until 1894, when the following amendment to the law establishing the Geological Survey was enacted:

"It shall also be the duty of said State Geologist to make a survey of the water-courses, ponds, lakes and swamp region of Georgia, and submit, in the report provided for, a topographical map showing the location, extent, means and plans of drainage, and also an estimate of the cost of said drainage of the ponds, lakes and swamps of Georgia. The said State Geologist shall also make estimate of the value and extent of the lands to be reclaimed by said drainage. The State Geologist is hereby authorized to employ two competent topographers and four assistant topographers and two drivers, as may be necessary to carry out the purpose of this chapter."

As the General Assembly failed to make the necessary appropriation for the payment of topographers, assistant topographers, etc., named in this amendment, no money was available to carry out the provisions of the law; but, nevertheless, a limited amount of work was done in Calhoun and adjoining counties under D. Lee Wardroper, chief topographer, with the hope that the next legislature would vote the necessary appropriation to continue the work. The Chickasawhatchee Creek, with its water-basin, was selected by Mr. Wardroper as the base of operations; and a period of nearly three months was devoted to field work. The surveying party under Mr. Wardroper began operations on April 17, 1895, and continued in the field until July 10, when the party was disbanded at Dawson, Terrell County.

The object of this survey was to obtain data for a topographical map and to ascertain whether or not the swamp lands of Southwest Georgia could be drained.

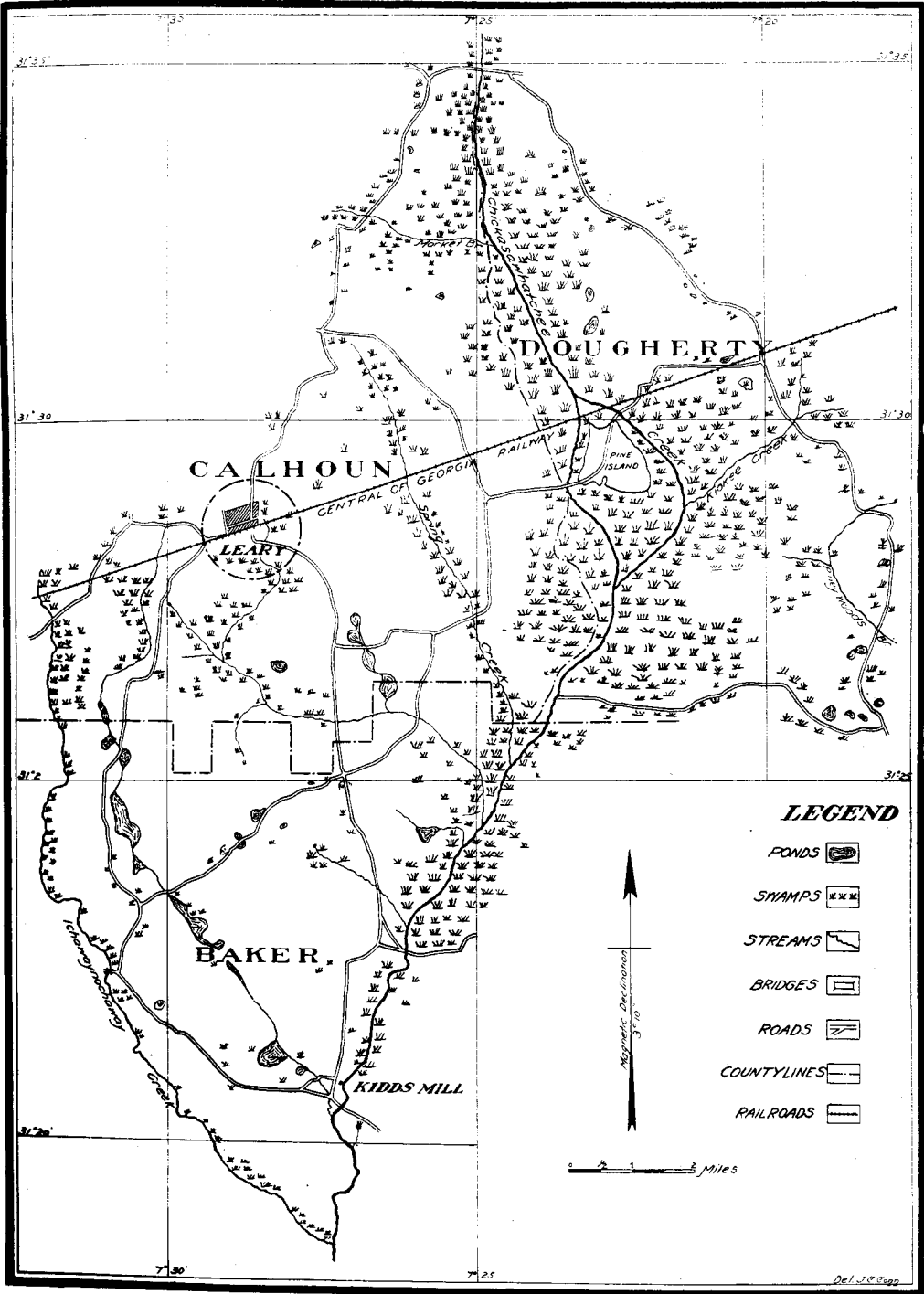
In view of the limited amount of money at the disposal of the State Geologist for this survey, it was considered advisable to confine the operations of the topographical party to the survey of the Chickasawhatchee Creek and the water-shed tributary thereto.

The Chickasawhatchee Creek rises in the central part of Terrell County and flows in a southerly direction from its source to its mouth. After passing the south line of Terrell County, it forms the boundary line between Calhoun and Dougherty counties, thence flowing into Baker County, it empties into the Ichawaynochaway Creek.

The area surveyed within the outside lines during the field season was one hundred and thirty and four tenths (130.4) square miles. Of traverse control lines, two hundred and sixteen and two tenths (216.2) linear miles were run, requiring the occupation by the transit of 2,315 stations. Seventeen elevations per square mile were taken and recorded, and the outlines of swamp within sight of the different traverse control lines were sketched in the field note book,

As a base line, Mr. Wardroper used the north rail of the track of the Central of Georgia Railway Company, "Blakely Extension." His starting point, or the station "0" of the survey, was the western extremity of the base line and may be described as follows: The center of the north rail of the main track at the west end of the Leary Turnout, and at the "toe" of the switch rail. He determined the latitude of said station "0" to be approximately $31^{\circ} 31' 30''$ north; and azimuth of the base line to be $71^{\circ} 44'$, counting from the north point in direction similar to movements of hands of the watch. The longitude of said station zero he computed from a large official map of the United States.

The instruments and facilities at hand prevented Mr. Wardroper from determining the absolute position of his starting point and base line. His determination of the position of said point is sufficiently accurate, however, for all present practical purposes. The "base line" is a fixed and permanent one, and if in the future a geodetic survey of the State be made, its position can be readily obtained



MAP OF CHICKASAWHATCHEE CREEK SWAMP, BY D. LEE WARDROPER

Del. J. G. Bagg

absolutely, and the map that he made and the field notes that he took can at all times be used, rendering totally unnecessary any resurvey of the territory.

From the base line, and distributed over the entire territory surveyed where they would be of the greatest use, over 2,200 points were geometrically located. From these locations the positions of all places and features of the surface were ascertained. These geometrical locations constitute what are called traverse control lines. The method used in carrying forward these lines was that which is usually designated as "stadia" surveying. In this method, while the horizontal angles, or the azimuth of lines, are measured in ordinary methods of surveying, the horizontal distances are not measured with chains, rods or tapes, but are calculated from certain spaces on the stadia rods observed between two horizontal wires in the telescope of the transit. This method is sufficiently accurate to be used to establish the location of points, from one base line, over a territory of 1,000 square miles. It is a rapid and an economical method of making a topographical survey and is about four times cheaper than the chain and transit method.

Relative elevations of all located points were taken and recorded. They were taken either by direct levels or by vertical angles. All the loops or polygons of levels closed (i. e. the work checked or was proved) to within less than one half of a foot, except two. The errors in these two are to be attributed to mistakes in reading the rod. In one polygon the error was two feet and in the other three feet. The polygons in which the errors occurred were outside ones and as their interior sides formed sides of other polygons, whose levels closed, these errors must have occurred in the outside lines and were so corrected.

Mr. Wardroper, in speaking of the drainage condition, says that the swamp lands of Southern Georgia, which cover a large portion of the country, may be divided into two classes—namely, creek swamps and pond swamps. Creek swamps in general are long and compara-

tively narrow and are bounded on the sides and the upper end by higher ground. Their limits are usually sharply defined by a bank varying in height from one foot to ten feet. Through these swamps, in tortuous courses, flow the creeks whose names they bear. The surface of the swamps on a transverse section is practically level, while on a longitudinal section the surface slopes from one and one half feet to five feet to the mile. While, in a straight open channel of uniform size, flowing full, an inclination of one and one half feet per mile is sufficient to produce a velocity or force in the water capable of moving fine sand, to spread the same volume of water over the rough and more or less obstructed surface of the swamp its velocity will be reduced to almost nothing. And as the ordinary flow of water in an obstructed creek, in its struggle with over encroaching vegetation and fallen trunks of trees is unable to maintain and deepen a permanent channel, but spreads out more or less over the swamp, it is readily conceived that the water level of a swamp is slightly above the ground surface at all seasons excepting those of droughts.

Swamp soil is a loose, black, spongy mud, which seems to be composed of decomposed vegetable matter and depositions from flood waters which often cover the swamp. Whenever drained and tilled, swamp lands have been found to be extremely fertile. Pond swamps differ from creek swamps only in the matter of drainage. The former, occupying depressions in the ground, have no natural surface outlet for drainage, while the latter do have such outlets.

Pond swamps occupy probably not more than 10 per cent. of the swamp area surveyed. As far as the salubrity of the climate is concerned, it is just as necessary to drain them as it is to drain creek swamps. In the solution of the problem of draining the swamps of Southwestern Georgia, no serious difficulties will be encountered, excepting in a few cases of isolated ponds.

The velocity of water in a channel 54 feet wide at top, 40 feet wide at bottom, and 7 feet deep, with a grade of one and one half

feet per mile, is 2.80 feet per second. A channel of this size, when flowing full, will discharge 924 cubic feet per second, or 89,833,600 cubic feet per 24 hours. This volume is equal to that of a rainfall one inch in depth (when duration of fall is 24 hours) over an area of 27 square miles. As, however, the country is quite flat, the velocity in the many tributary streams will be small, rendering it impossible for the rainfall from the outlying districts of the watershed to reach the main channel within the duration of the rainfall, consequently, for this reason, the main channel will not be subjected to the full duty of discharging the total amount of rainfall in the same length of time it may be falling. And further, as limesinks, ponds and subterranean water courses, which abound in the country, divert a large part of the storm water from the main lines of drainage, it is safe to assume that not more than one half of such rainfall mentioned above would ever find its way into the main drainage channel in the time that the rain was falling. Therefore, a channel of the above size would not only be of ample size to drain the swamp and to carry off the ordinary flow of the creek, but would, furthermore, be of sufficient capacity to carry off the storm water from a water shed of 54 square miles.

The above is simply given as an example of what can be done on an inclination of one and one half feet per mile. This grade is, however, the minimum that need ever be met with in the territory. The average grade would be between three and four feet per mile, which would call for much smaller channels proportionately for purposes outlined above.

Under the present conditions of drainage in Southwest Georgia, the vital forces at work in the vegetable kingdom, aided by depositions from flood waters, are augmenting the depths and areas of the swamps. Change this condition and assist some of the destructive forces of nature, and the swamps will disappear, giving place to rich fields yielding bountiful harvests; the healthfulness of the country will be improved; the vigor of the inhabitants will be increased;

farming in all its branches will thrive; room will be made for new capital and new people; taxable values will be raised, and where the state receives cents in taxes now it will receive dollars then.

It is not within the scope of this preliminary report to elaborate a proposed plan of drainage, nor to estimate the cost of such a work, nor to pro rate this cost to each acre of swamp land that may be reclaimed. This information would be most desirable and can be readily obtained when the topographical survey is continued far enough at least to take in one complete watershed to that creek where drainage may be under consideration. The area of the watershed, the amount of duration of rain storms, the proportion of the rainfall which runs off through subterranean passages, and the ordinary flow of the water in the creek are factors which must be known before an intelligent design of a system of drainage can be made.

An estimate based upon Mr. Wardroper's map shows that, within the area surveyed, there is approximately 32,000 acres of swamp land which might be reclaimed by drainage, distributed as follows: Baker County, 5,000 acres; Calhoun County, 11,000 acres, and Dougherty County, 16,000 acres.

FEDERAL GOVERNMENT

In addition to the drainage investigations above referred to, the Federal Government, under the direction of the Office of Experiment Stations, U. S. Department of Agriculture, has done considerable preliminary work in South Georgia investigating the swamp and overflow lands. The preliminary surveys all of which have been made in the last two years, cover all, or parts of the following counties: Chatham, Bryan, Liberty, McIntosh, Glynn, Clinch, Echols, Jackson, Telfair and Floyd. The reports on these several counties, which occur in the following pages of this report, show a very large acreage of swamp and overflow lands of high fertility, much of which can be reclaimed at a comparative small cost.



FIG. 2



FIG. 1.—CULTIVATED "SECOND BOTTOMS," WEST SIDE OF FLINT RIVER,
NEAR MONTEZUMA, MACON COUNTY

FIG. 2.—PYLES MARSH, AT LOW TIDE, ELEVEN MILES NORTHWEST OF
BRUNSWICK, GLYNN COUNTY

HOW THE STATE WOULD BE BENEFITED BY THE DRAINAGE OF
SWAMP AND OVERFLOW LANDS

By an examination of the last report of State Comptroller-General Wright, it will be noticed that the so-called unimproved lands of the coast counties of Georgia, which lands include all of the swamp and overflow lands, are valued at from \$0.67 to \$1.26 per acre, or an average less than \$1.00 per acre. Swamp lands, I am informed, in many places can actually be purchased at from \$2.00 to \$3.00 per acre.

It is a well-known fact that both swamp and overflow lands are, as a general rule, remarkably fertile, and when properly drained and cultivated, yield luxuriant crops. Lands of this character in Georgia, where favorably located, should bring at a low estimate \$50 or more per acre, or fifty times their present assessed valuation, as shown by the tax returns. In case these lands were drained, the State, instead of receiving, as it now does, an annual income in taxes to the amount of \$13,500, should receive \$675,000. It is true that this estimate is made on the supposition that all of the swamp and overflow land be reclaimed, which will probably never be completely realized, nevertheless, the ratio of increase in taxes to the State will hold good for every acre of land drained and put under cultivation.

In addition to the increased money value to the State in the form of taxes, the reclamation of these lands will add greatly to the health of the section wherever drainage is carried on. It is a well-known fact, recently demonstrated by the medical profession, that malarial diseases, so prevalent in swamp lands, are due to the bite of a certain species of mosquitoes which almost invariably abound in greater or less numbers in such places. The drainage of swamp lands destroys the breeding places of these insects, and as a result malarial diseases disappear. The census of 1870 gave the number of deaths from malaria in Indiana, Illinois, and Iowa for the preceding year as 52.5 per thousand of the total; while the census of 1890, when large

areas of land had been drained, the death rate, due to malaria, was only 8.6 per thousand. For the east coast lands of Georgia, South Carolina, and Florida, the death rate from malaria in 1870 was 66.2 per thousand, and in the same states in 1890 the rate was 61.7 per thousand. These figures show that malarial conditions did not materially change in the three last named states during the two decades, which is accounted for, in a large measure, by the lack of drainage improvement. The facts brought out in the comparison of these two groups of states, in one of which drainage had been carried on to a large extent, and in the other but little or no drainage was attempted, demonstrate conclusively that malaria depends largely on swamp conditions, which can be removed by drainage.

Drainage Examinations and Surveys

IN

GEORGIA

CONDUCTED BY

Drainage Investigations

Office of Experiment Stations,

U. S. Department of Agriculture,

1908-1911

FOREWORD

The need for drainage in Georgia, particularly in the coast counties, has been brought to the attention of this office many times during the past three years, and in response to requests, several preliminary drainage examinations have been made in order to determine what will be necessary to effect the reclamation of these swamp lands.

The following is a collection of reports of various preliminary examinations, including the proposed drainage improvement of McRae Branch, Telfair County, a drainage plan for the Berry School Farm, Rome, Floyd County, and the proposed improvement of the Mulberry River, in Jackson County, the latter having been worked out in full for the use of the landowners. The names of the several engineers who conducted the work and reported on the various projects are given at the head of each report.

The interest which has been aroused in the subject of drainage throughout the State and the desire of the landowners in many localities to carry out works of considerable magnitude, emphasize the need of a general drainage law. A drainage bill has been prepared and will be presented at the coming session of the legislature, and for this reason it is desired at this time to present the information that has so far been collected by this office relating to the drainage conditions in the State so that the subject may be intelligently considered.

The drainage situation in Effingham County has also been made the subject of a special examination and a report upon same is here omitted as it is hoped that in the near future the report will be published as one of the Circulars of the U. S. Department of Agriculture.

It is expected during the coming year that Drainage Investigations, Office of Experiment Stations, U. S. Department of Agricul-

ture, will co-operate with the Geological Survey of Georgia in continuing the drainage examinations and surveys which have already been initiated.

Aside from the great change which will be effected in agriculture and agricultural methods by the reclamation of the swamps and wet farm lands of the coast counties and the overflowed valley lands throughout the State, a great benefit will be derived by changing many unhealthful localities into those suitable for habitation throughout the year. This benefit alone will, without doubt, contribute greatly to the prosperity of the State.

C. G. ELLIOTT,

Chief of Drainage Investigations.

Washington, D. C., May 10, 1911.

Bryan County¹

BY J. V. PHILLIPS

Assistant Drainage Engineer, U. S. Department of Agriculture

LOCATION AND DESCRIPTION

Bryan County, as will be seen from the map, is a long, narrow county situated just west of Chatham County, in which lies Savannah, Georgia's chief seaport. Bulloch County lies to its north, the Ogeechee River forms its eastern boundary line, the Atlantic Ocean bounds it on the south, and the Cannouchee and Medway rivers form most of its western boundary line.

It is traversed by three competing lines of railroads. The Seaboard Air Line crosses the northern section of the county, while the Seaboard Air Line and the Atlantic Coast Line cross the south central section of the county. The Savannah and Statesboro Railroad affords transportation for the extreme northeastern section of the county.

The county has many swamps over the entire area, all of which afford independent outlets for their respective sections, or would do so if they were improved. Practically every section or locality in the county was visited and the conditions existing in each were studied, both by questioning the more prominent landowners and by personally riding over different sections of these creeks, which are merely flat swamps in many cases.

Some of the more prominent outlets in the county are: Cana Branch, Mill Creek, Black Creek, Savage Creek, Cross Swamp and Mill Creek No. 2, all of which are shown on the map.

¹Field Examination made January-February, 1910.

NATURAL DRAINAGE CHANNELS AND OUTLETS

Although Cana Branch is several miles in length, it has a good fall and the landowners from its head to five or six miles below desire to improve that section. As the lands bordering along the branch are low, flat wood lands, at wet times the excessive water held in the swamp along the branch soaks into this higher land, thus doing it much injury. By digging a suitable canal along the branch an area of about two to three miles in width can be thoroughly drained. The body of the swamp, itself, varies from a few hundred feet to a quarter of a mile in width.

Mill Creek No. 1, Black Creek, Savage Creek and Cross Swamp each have about the same sized water shed as Cana Branch. Each also has its swamp with its more or less open run, along which the black mud lands vary in width from one eighth to a half mile. The soil is about two to three feet deep, underlain with sand; however, a light brown or red clay is found in places. The area to either side of the swamp is flat, low lying, and badly in need of drainage. This area varies from a light sandy loam to a sandy soil, yet there is very little of these lands that are too sandy for profitable cultivation after drainage.

As mentioned above, the county is well covered with swamps, each of the larger swamps having its numerous tributaries and chains of ponds or depressions leading back into the higher lands. The Ogeechee River on the eastern boundary of the county and the Cannouchee on the western boundary line afford ample outlet for these several swamps, yet in their present condition, with their poor "runs" and thick undergrowth, these swamps and tributaries are worthless as outlets during wet times when the flat wood lands lying in their watershed area unfit them wholly or partially for cultivation.

TYPICAL AREA NEEDING DRAINAGE

In the northeastern section of the county is the home of Mr. Quincy Edwards, who owns about a thousand acres or more of good



FIG. 2



FIG. 1.—MAULDIN SWAMP, BRYAN COUNTY, GEORGIA
PHOTOGRAPH BY J. V. PHILLIPS, 1910

FIG. 2.—CANNOOCHEE RIVER, BRYAN COUNTY, GEORGIA
PHOTOGRAPH BY J. V. PHILLIPS, 1910

mud land and sandy loam. There is a chain of ponds or depressions on this land leading to Black Creek, a distance of some three miles. The area on either side that would be benefited by draining these ponds is about a mile or more in width, flat and very fertile, being a dark sandy loam. The ponds themselves contain gum and cypress, and have a black mud soil with a clay subsoil.

DRAINAGE OF THE PAST

Regarding practical drainage, there has been none undertaken in this county since the days of slavery. Practically all of it at that time was for the culture of rice. With few exceptions this was practiced along the rivers in the tidal belt. To-day old drains and embankments have all been entirely neglected and allowed to go to ruin. In Mauldin Swamp, just southeast of Cana Branch, there is an old cleared field containing about 100 acres. This field was cleared and thoroughly drained by slave labor years ago, and it is said that 50 bushels of corn and rice were grown per acre, while a bale of cotton was made on the same area. The swamp has a very rich black mud soil, about three to four feet in depth. Black gum is the prevailing timber, and there is several feet fall per mile. The swamp varies in width from one fourth to one half mile, with a good sandy loam woods land on either side in the water shed. Some of the landowners in Cana Branch watershed also own lands in this watershed, and it is only a question of time until this swamp will also be brought under cultivation.

PRESENT FARMING CONDITIONS

The farming conditions are about the same as are usually found in localities that have much swamp land. The people are living on the higher places, which, though by far the poorer lands, are mostly free from excessive water. The major portion of the farmers depend to a great extent upon either the timber or the turpentine interests for most of their subsistence, and little attention is paid to raising crops. Fifteen to forty bushels of corn can be made per acre, from a half to a bale of cotton, about 300 gallons Georgia cane syrup, and

about 300 to 400 bushels sweet potatoes, and good hay crops. Few at present have given much attention to the science of better farming, but with a change in the convict system of the state whereby each county is building good roads, a rapid improvement is expected. Bryan County already has many miles of well-graded road-bed, and the system is extending over the entire county. There is now being projected a railroad from without the county, which, if the charter is followed, will go through Pembroke down to Clyde, the county seat, and thence to Ways Station. This will afford the people the very best transportation facilities throughout the farming section. That section of the county south of Ways Station, though very rich for the most part, is held to the extent of about 90 per cent. by wealthy Northern men and by clubs for hunting purposes solely. Little farming is practiced in this section, save on a very small scale by a few negroes. The examination was continued as far down as Keller P. O. It was found that the tide usually comes up the Ogeechee River into the Cannouchee River, about three miles south of Clyde.

CONCLUSION

Having a semi-tropical climate, a good rich sandy loam soil over the most of the county, being near a good trucking market, and having fair transportation, by instituting drainage in this county, it can be benefited beyond the most sanguine dream of the inhabitants, for 80 per cent. of the lowlands may, at a very small cost, be brought under very profitable cultivation.

The two localities most interested in drainage at present are the Cana Branch District and the district in the northeastern part of the county previously mentioned. In each of these places a main canal down the swamp will be all that is necessary.

Chatham County¹

BY J. V. PHILLIPS

Assistant Drainage Engineer U. S. Department of Agriculture

LOCATION AND DESCRIPTION

Chatham County is situated on the extreme eastern part of Georgia's coast and has for its only large town Savannah, the chief seaport of Georgia. The county being very swampy and unhealthy, years ago practically all the population of the county settled in the city of Savannah itself. Because of the unhealthy conditions prevailing in and about the city, the county authorities some 25 years ago began **draining** the swamps near the city to rid themselves of the malarial conditions which were then so prevalent.

Mr. Albert Wiley, chairman of Chatham County's Drainage Commission, took great interest in explaining the general conditions existing years ago when he first undertook this work, contrasting it with the first-class conditions existing to-day, and explaining in detail the different steps in the great work. Mr. W. F. Brown, County Engineer for the past twenty years, kindly went over the many maps and plans in his office with the writer. These county maps are from accurate surveys made by Mr. Brown. The detail maps show an accurate meander of all the swamps, and there are also shown many other natural features. Accurate levels over the entire county have been run and these are shown on the map in parallels one thousand feet apart.

PRESENT DRAINAGE CONDITIONS

In the past twenty years the county has constructed over 800 miles of canals and ditches in the county with convict labor. These canals are principally near Savannah, though they are gradually extending

¹Field Examination made February 25-29, 1910.

throughout the entire county, as the available labor will permit. The most of Chatham County being low and the fall very slight, tidewater once reached far back into the interior, but the county has constructed very strong, substantial tide gates at the several necessary openings until now they have five in all—viz., Casey Canal Gate, Dundee Gate, Pipe Maker Gate, Augustine Gate, and Buckhalter Gate. These gates vary in cost from \$6,000 to \$10,000, which cost includes a reinforced concrete bridge over the canal. These gates have proven very satisfactory in the past and I consider them of the best type. Some of the canals have a bottom width as large as 40 feet and the engineer has given them slopes of one and one half to one, as it is considered that the soil through which the canals pass would cave in with steeper slopes. In the swamps the black vegetable matter is about four to six feet deep, and, of course, very fertile. The swamps practically all have a blue clay subsoil which is impervious. As above mentioned, the slope is slight in the swamps and the expense of keeping the canals cleaned out is great, due largely to a grass which grows up in the bottom of the canals and forms a thick "matty" mass. Within the past few years the delegation from Chatham County secured the passage of a bill by the State Legislature making it compulsory for the landowners of any of the swamps to construct laterals to the different mains, where these mains were for the public health of the county. They must also keep said mains in such condition that the flow will not be retarded.

OPPORTUNITIES

Though many thousand acres in the county have been reclaimed by the above-mentioned process, practically all the landowners live in the city of Savannah and have a few tenants, principally negroes, living upon small clearings. The entire county was examined and the different projects under construction were visited. In the northeastern part of the county, about Monteith and Meinhard, is found the best truck gardening section. This is a progressive German settlement.



FIG. 2



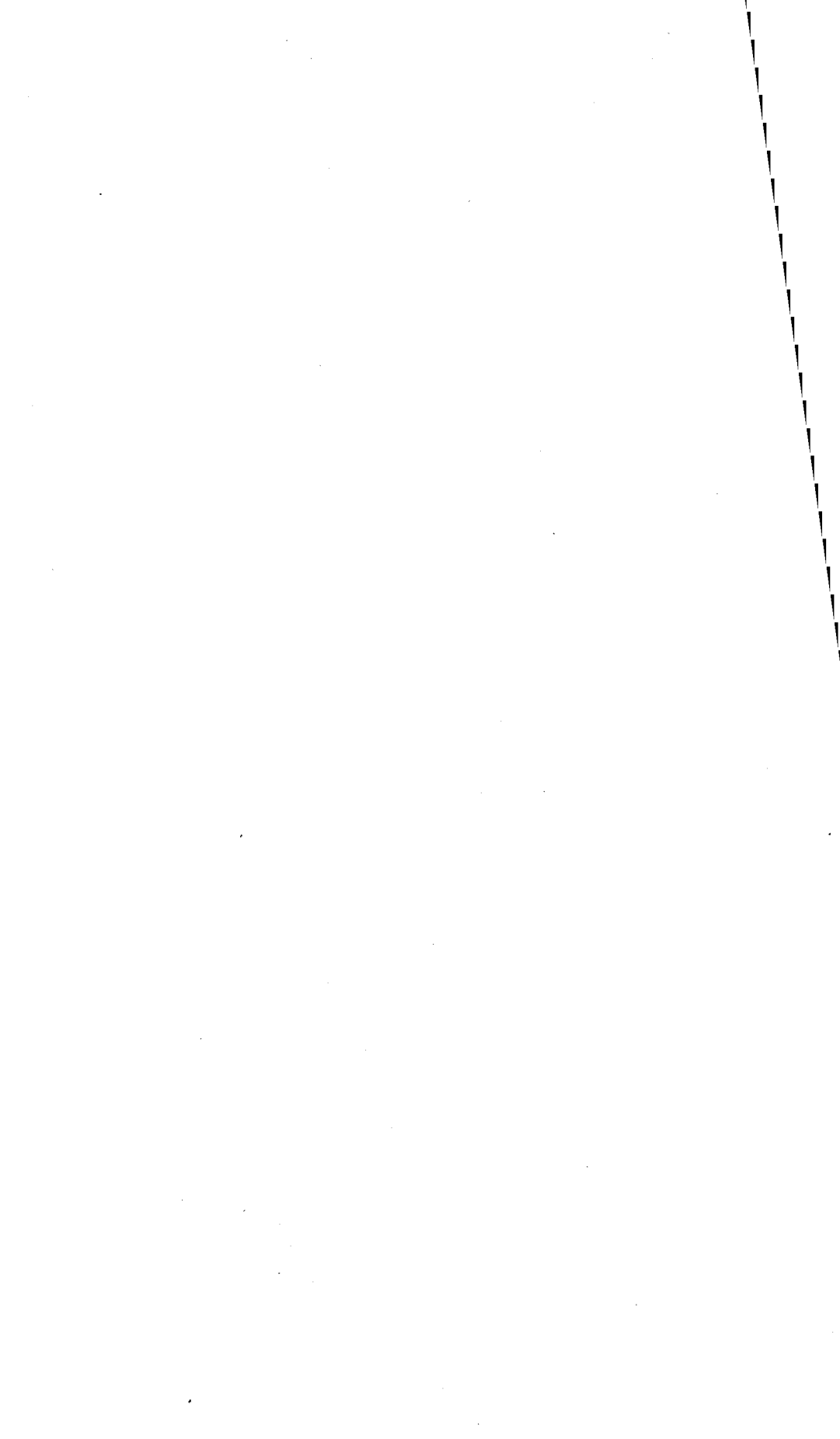
FIG. 1.—CROSS SWAMP, NEAR CLYDE, BRYAN COUNTY, GEORGIA—TYPICAL OF THE GUM SWAMPS OF THIS SECTION AS TO SIZE OF TREES
PHOTOGRAPH BY J. V. PHILLIPS, 1910

FIG. 2.—TYPICAL LOW-LYING FLAT WOODS, NEAR CLYDE, BRYAN COUNTY, GEORGIA, SHOWING THE EFFECTS OF THE FOREST FIRES WHICH OFTEN FOLLOW IN THE WAKE OF THE TIMBER AND TURPENTINE OPERATIONS
PHOTOGRAPH BY J. V. PHILLIPS, 1910

Chatham County, situated as it is, with its semi-tropical climate, its fine fertile soil, and the best of transportation facilities, should become a great shipping point for truck garden produce. Besides the great drainage works which the county has built, it has also constructed over a hundred miles of the best gravel road-bed traversing the greater part of the county. The expert from the U. S. Department of Agriculture, Good Roads Office, said, after inspecting the roads, that he could offer no suggestions for their betterment. From the above it will be seen that transportation from the farm to the city or railroads is the best one could wish for, while trunk lines of the Atlantic Coast Line Railroad, the Seaboard Air Line Railroad, the Southern Railroad, and the Central of Georgia, all afford quick transportation to the Northern market.

CONCLUSIONS

It will be seen from the above discussion of conditions existing in Chatham County that the only thing needed in this county is taking advantage of the excellent opportunities offered. The greater part of the county could well be given over to truck gardening. The drainage work is being carried on in a most complete, thorough, and scientific manner under the direction of Mr. Brown, the County Engineer, who gives his entire time to the draining of the county and the scientific construction of roadways.



Clinch and Echols Counties¹

BY J. V. PHILLIPS

Assistant Drainage Engineer U. S. Department of Agriculture

LOCATION AND DESCRIPTION

The Suwanoochee Valley lies principally in Clinch County, but the southern extremity for some miles forms the boundary line between Clinch and Echols counties. A branch of the Atlantic Coast Line Railroad crosses the upper end of the valley, another branch runs along the valley for some seven miles south of Dupont, while a branch of the Georgia Southern & Florida Railroad crosses the valley along about its central part.

The area of the proposed drainage district examined embraces about 120,000 acres, having a maximum length of about 40 miles and a width of about five miles. This area is low and flat, having a gentle slope to the Suwanoochee Creek bottom, which varies in width from one fourth mile to one half mile. The flat area on either side of the creek bottom is dotted about with ponds or bays, some of which have no outlets, while still others have a connecting chain to the creek bottom.

The Suwanoochee Creek is the main outlet for this area, while there are small swamps leading into the creek which are called creeks or branches, and which carry some water during wet seasons. The Suwanoochee Creek bottom, itself, has no well-defined channel until a point a few miles above its mouth is reached, and even here it needs much improvement. The Suwanoochee having no well-defined channel for carrying the run-off during wet times, causes the area bordering along it to be flooded. There has been no drainage at all up to the present time in this locality, no attempt even having been made, save for some few small shallow field ditches in Fruitland.

¹Field Examination made January 5-11, 1910.

FARMING, CROPS AND SOILS

Of the 120,000 acres there are probably 3,000 to 5,000 acres cleared for cultivation, a great part of which is cultivated, but not according to modern methods. A great part of the land being held in large tracts by the turpentine or timber interests, who work the turpentine or sell the timber for ties or lumber, has caused very little interest to be manifested along agricultural lines.

Cotton, corn, sweet potatoes, Irish potatoes, rice, and nearly all crops suitable to a semi-tropical climate can be grown. The cotton crop (which is the long staple) varies from about one third bale to two bales per acre. The corn crop varies from 15 to 40 bushels per acre, the sweet potato averages about 250 bushels per acre, and the Irish potato about 100 bushels per acre. This is also a great pecan country, though there have been very few trees as yet in this immediate territory.

The soil is of about three distinct classes. In the northern part of the district there is a clay soil, but farther south along the valley this changes to a sandy loam, being very sandy at the lower end of the valley. There the creek bottom, which is an average of about one third mile in width, has a dark, rich, loamy soil. A good brown or red clay subsoil underlies the entire district, varying in depth from the surface.

TRANSPORTATION AND ROADS

As before stated, the valley is served by three branches of railroads running through it. These roads all run convenient schedules and give ample service with sufficient traffic and freight accommodation. There are, however, very few roads for private conveyances and these are only narrow trails.

NEED OF DRAINAGE

Lumbering, tie and turpentine industries have occupied the people almost solely up to the present time and the subjects of more extensive and more intensive farming have been given very little thought and the matter of the drainage of wet lands has not been considered.

Finding these conditions, an address was made by the writer at a meeting at Dupont, N. C., on Tuesday, January 11, 1910. This was thought necessary because of the principal landowners being widely scattered in many towns. Twenty-five or more persons were at the meeting and some interest was manifested. An explanation was given of the policy of the Drainage Investigation Office and of the progress made in drainage in the past few years. The State Senator for this district and the editor of the only paper in the county also made a few timely remarks.

The drainage necessary will be a main outlet down along the Suwanoochee Creek bottom to the mouth, a distance of some 40 miles. Also some laterals through these "characteristic palmetto flat woods." For a good description of this area see "Soil Survey of the Waycross Area," published by the Bureau of Soils, U. S. Department of Agriculture. This soil survey joins Clinch County and, in part, is a good description of this section, save for the rolling area described in that bulletin.

A drainage survey should include some five or six miles in width lying along the Suwanoochee Valley and extending the length of the valley. The country is very sparsely settled, so that a camp outfit would be necessary for such work.

Glynn County¹

BY F. G. EASON

Assistant Drainage Engineer U. S. Department of Agriculture

LOCATION AND DESCRIPTION

The examination of Glynn County was conducted with Brunswick as a base, and from here the various parts of the county were reached by train, automobile, buggy, horseback, and steamboat. All sections of the county were inspected and the various problems looked into.

Glynn is one of the coast counties of Georgia, lying between McIntosh and Camden counties. It has an area of about 500 square miles and a population of 15,000. Brunswick is the county seat and largest city. For the most part, the county is low and flat, and cut up by tidewater creeks and marshes. In nearly all cases the head waters of the creeks are long, narrow swamps, which are the natural drainage channels of the county. These flat lowlands extend up to the northern and western parts of the county, where a high, sandy ridge is encountered. There are many smaller swamps making into these long swamps, thus forming a network of swamps. Buffalo Swamp is the largest and it crosses almost the entire county.

NATURAL DRAINAGE CHANNELS

There are three main drainage channels in Glynn County. The first is the Altamaha River, which drains the northern part of the county. Its watershed will be found to be comparatively small, making most of the drainage come to tidewater. This river is the line between Glynn and McIntosh counties. The second is the Little Satilla River draining the southern part of the county. It forms the boundary between Glynn and Camden counties. The third is Turtle

¹Field Examination made February 8-28, 1910.

River and it drains the central portion. These last two are hardly more than small tidewater rivers. There are no tributaries of any note to any of these rivers.

SOIL

The soil of Glynn County is very fertile and worthy of special mention. There are four distinct kinds of soil to be found here. 1. On the coast, the soil consists of a light, sandy loam, underlain in most places by a light, yellow clay. This soil is sometimes called "hammock" and is considered to be well adapted to truck raising. 2. About six miles back from the coast a clay is encountered which is of a light yellow color and very thick. In many places it can be seen cropping out and is hardly ever more than five to eight inches below the surface. It is underlain by a hard-pan several feet from the surface. There is more of this soil than any other, in the county, and, as it is very fertile, a system of drainage would make it produce large crops. 3. From 20 to 25 miles from the coast, a very heavy sand is encountered. In some places it is underlain by a clay subsoil and in others it extends downward for many feet. Very little of this class of soil exists in this county. 4. The swamp soil of Glynn County is by far the most fertile. It consists of a heavy black muck many feet in depth. It is, in many cases, almost peat, and if dried out will burn. With the diversified soil in this county there is no reason why Glynn County could not be made the garden spot of Georgia, if the lands were only drained.

NATURAL DRAINAGE CONDITIONS

The entire county can be benefited to a great extent by a careful system of drainage. The low, flat section is traversed by many swamps which empty into tidewater rivers. These swamps, with one or two exceptions, are the natural drainage channels, and as none of them are opened up, great harm results. They are all choked up by brush and timber, and as a consequence, the water can not run off rapidly enough. These flat lands are also injured to a great extent by standing water. They have too light a slope to insure good

drainage and they, therefore, need ditching very badly. In one section of the county there is an overflow to contend with, but it is not as bad as in some of the other coast counties. The water breaks out from the Altamaha River in times of high freshets and runs through the Buffalo Swamp. It also overflows a portion of the clay lands in the vicinity of Thallman and Everett. This could be prevented by building several levees across the swamps where they leave the River Swamp.

The amount of drainage existing in the county to-day is very small. What land is cultivated is, for the most part, fairly well drained by a system of ditches. As practically all of this land now cultivated is near some tidewater creek, its drainage is very simple. There is a large canal about 50 feet wide running from the Altamaha River to Brunswick, which, by a little cleaning out, could be utilized for a drainage canal. It was dug during slavery times with slave labor and used as a short cut to bring various products to Brunswick. It is not used now.

FARMING CONDITIONS AND CROPS

Farming, as a profession, is coming into vogue here more and more every year. The intelligent, progressive farmers realize that the proper way to farm is by the use of modern scientific methods. Several colonies have been started here, but have for the most part proved a failure on account of the lack of drainage. One of them is being tried now, but they realize that they can not do much without drainage and the promoters are very anxious to have the work done and are willing to pay their share of the costs. A very small percentage of the county is under cultivation to-day and much of this is farmed in small patches by negroes. There are large areas of clay lands that can be brought into cultivation very easily, if drained, there being scarcely any growth on it.

The land that is cultivated here raises very good crops with the aid of fertilizers, the crops being above the average for the State. The land seems to be well adapted to corn, and from 35 to 75 bushels per

acre are raised. There is a wide range in the kinds of soil and, consequently, a wide range of crops. Those grown most are corn, cotton, peas, potatoes, cane, oats, forage crops, and truck. In times past, a great deal of this land used to yield a bale of Sea Island cotton to the acre. Experiments are being made here in celery, with a view of growing it extensively on a commercial scale, and they seem to be fairly successful, although they have had a very unfavorable winter. There is a large movement on foot to have the farmers plant more cotton, and there will be about 500 acres planted this year. Fine Sea Island cotton used to be raised here before the war, but the industry has died out, and it is for the purpose of reviving it, that the organization was formed.

TRANSPORTATION FACILITIES

The transportation facilities in the county are very good. There are three railroads running out of Brunswick—the Southern Railway, the Atlantic Coast Line, and the Atlanta, Birmingham & Atlantic. The Seaboard Air Line crosses the western portion of the county. The roads are very good for the most part, there being many miles of shelled and clayed roads. They are kept in good condition by convict forces. As there are plenty of waterways, transportation by boat is often used. Glynn County has the best roads of any county south of Chatham.

DRAINAGE PLAN PROPOSED

The kind of drainage most needed now in Glynn County is the opening up of all the large swamps, so that they can serve as outlets for the smaller drains. There are several of these large swamps which cross the county, and by opening them up and constructing numerous laterals, most of the county could be effectively drained. The section bordering the coast can be easily drained by the individual owners of the land. St. Simon's Island was visited and was found to have fair natural drainage, but in a few instances some very fine savanna land could be put under cultivation by the construc-

tion of ditches. The island was nearly all cultivated at one time, but is cultivated to a very limited extent at present.

No particular difficulties will be met with when a survey may be made, as there is no very thick brush, although the swamps are heavily timbered. Such surveys would have to be made from a camp, as houses are scarce. There is no difficult problem to solve, unless it be the taking care of the overflow water from the Altamaha River.

No definite drainage project has been formulated here up to the present time, but there possibly will be some later. A great deal of interest in drainage has been aroused by the investigation, as it has, in a measure, made the landowners realize the possibilities of their lands.



FIG. 2



FIG. 1.—BRIDGE OVER GUM SWAMP CREEK, TELFAIR COUNTY, GEORGIA,
ONE MILE NORTHEAST OF McRAE, OLD BRIDGE AT RIGHT

PHOTOGRAPH BY J. V. PHILLIPS, 1910

FIG. 2.—GUM SWAMP CREEK, NEAR McRAE, TELFAIR COUNTY, GEORGIA,
LOOKING UP STREAM FROM BRIDGE ON ONE OF THE FOUR CHANNELS

PHOTOGRAPH BY J. R. HASWELL, 1911

Liberty County¹

BY F. G. EASON

Assistant Drainage Engineer U. S. Department of Agriculture

LOCATION AND DESCRIPTION

There is no drainage organization of any kind in Liberty County, but there are a number of persons interested in drainage.

The examination was conducted by visiting the different points in the county by train and team. Those who were interested in drainage were interviewed and their opinions on the subject obtained. They were also asked to describe the conditions in their several localities, and afterwards a personal inspection of the territory was made. As a part of this county had already been visited and described in the report on McIntosh County, December, 1909, it will not be necessary to give a detailed description in this report. Attention is called to the similiarity of Liberty and McIntosh counties. They are adjoining coast counties of Georgia and resemble each other very closely in natural conditions and in other respects.

Liberty is one of the largest counties of Georgia, having an area of 976 square miles and a population of 13,000 people, two thirds being negroes. The county seat is Hinesville, and it has no railroad connection.

The soil of the county is of two different kinds. The coast and northern sections are sandy, with a light clay subsoil, and the central and southern parts are very fertile alluvial clay, deposited from the Altamaha River and known as the "flat clay lands."

NATURAL DRAINAGE CHANNELS

The main watershed runs through the central part of the county in an east and west direction, the main drainage channel for the southern

¹Field Examination made January 21-February 2, 1910.

part of the county being the Altamaha River, the main tributaries of which are Beard's Creek, Jones Creek, and Doctor Creek. For the northern part, the Cannouchee River furnishes the outlet and its main tributaries are the Little Cannouchee River and Taylor's Creek. The eastern part drains to the Atlantic Ocean, its main streams being the South Newport River, North Newport River, and Medway River.

THE DRAINAGE SITUATION

The county has good natural drainage as a whole, but there are several localities which can and need to be greatly improved. In the coast section, a great deal of drainage is needed. The proposition here however is a comparatively easy one, as the whole section is a network of tidewater rivers and creeks, thus giving many drainage outlets. Before the Civil War, this section had a complete and thorough system of drainage, and fine crops were raised. It was then the richest section of Georgia, but the large owners have either left or allowed the places to run down, until to-day, all that remains of a once fine system, are a few overgrown ditch banks. It is a section of by-gone days. Drainage here would be a matter of individual activity, as nearly all of the places are on some outlet creek.

The northern part of the county is high, sandy, rolling land, and the drainage is very good into the creeks and rivers through the branches and swamps. It could be improved in some instances by opening up these swamps.

The central and southeastern part of the county is the section to which I desire to call especial attention, as it is annually overflowed and the drainage here is very poor. This is the section which has already been referred to as the "flat clay lands," but it is really the alluvial plain of the Altamaha River. All of this section can be reclaimed by building some short levees along the river and by digging canals through the swamps to the tidewater rivers of the coast. It is necessary for McIntosh and Liberty counties to work in conjunction in this matter.

The farming conditions of the coast section are very poor. What

has been written about this section of McIntosh County applies to Liberty County as well. There are a few small farms in this locality, but a great deal of the land here is owned by negroes.

On account of the overflow conditions and lack of drainage in the "flat clay lands," no farming is done here. The section north of the Atlantic Coast Line Railroad is the best farming section of the county. It is not meant that it is the best land, but the conditions are best suited for farming. It is high and well drained and the farmers raise very good crops by the use of much fertilizer. The chief crops are corn, cotton, potatoes, and cane.

TRANSPORTATION

The transportation facilities throughout the county are not very good. There are three railroads. The Atlantic Coast Line traverses the central part, the Seaboard Air Line the eastern part, and the Georgia Coast and Piedmont the western part. The entire northern part of the county is without a railroad. The roads are in fair condition, and a few small boats ply up and down the large rivers and connect with the coast.

CONCLUSION

The coast drainage conditions have already been described, so nothing further need be said. The people of the northern section are wideawake, progressive farmers, but are not much interested in drainage. The owners of the "flat clay lands" fully realize the possibilities of the land and are willing to form a drainage district. The examination in this section of the county was quite thorough and it was found that the people were very enthusiastic over the project.

The kind and system of drainage thought to be necessary will be explained in the McIntosh County report. The system will have to be extended up the western part of the county, between the Altamaha River and the Georgia Coast & Piedmont Railroad nearly to Beard's Creek.

The kind of drainage survey has also been described. The work in

the western part of Liberty County can be done without a camp, as farm houses are numerous.

The idea of making this into a trucking section seems to be growing in favor every day. The present market value of these lands is from \$2 to \$3 per acre, which compared with the present value of good truck lands in the south indicates the opportunity here for improvement and investment.

McIntosh County¹

BY F. G. EASON

Assistant Drainage Engineer U. S. Department of Agriculture

Some of the largest landowners in McIntosh County are interested in drainage, and some of them very kindly took the writer over the county. No map of the county could be procured, so a State map had to be used. The examination was conducted by getting all the information possible from the residents and by later riding over the country on horseback, buggy, and train.

LOCATION AND DRAINAGE CONDITIONS

McIntosh County is one of the coast counties and consequently is very similar in physical conditions to the other coast counties, that is, low and flat with numerous swamps. It is a small county, containing 308,000 acres and about 9,000 people, the majority being negroes. The part most needing improvements and to which most attention was paid is the northwestern section of the county. This locality is annually overflowed by freshets from the Altamaha River, which forms the western boundary of the county. This water overflows at a point in the northern part of Liberty County through Beard's Creek, and also at several other small places down the river in Liberty and McIntosh counties, overflowing in all about 200,000 acres. There is on both sides of the river a swamp from one to two miles wide called the River Swamp. This swamp is also overflowed, but it would not be practicable to try to protect it, as a very high levee would be required along the entire river bank at a very great cost. The eastern boundary of this swamp is a narrow ridge of sandhills, known as the River Sandhills, varying in width from 100 to 500 feet. These

¹Field Examination made December 9-17, 1909.

hills are very high and form a natural levee paralleling the river. There are several gaps in this ridge through which the water flows, and as stated above, also through Beard's Creek. One of the gaps is about six miles north of Barrington and is about 600 feet wide. Another is right on the line between Liberty and McIntosh counties and is about 500 feet wide. There are several other small gaps near the Atlantic Coast Line Railroad from 50 to 200 feet wide. All of the water comes through these small openings. During a freshet, the water from the river backs up Beard's Creek and overflows the lowlands, being augmented on the way down by water from these gaps. A portion of this overflow water goes back into the Altamaha River below Barrington, but the greater part of it flows down these flat clay lands paralleling the river for a distance and then spreads out over the entire country, (Tibet to Eulonia) finally emptying into the Atlantic Ocean through the South Newport and Sapelo rivers. The land north of Tibet and east of Ludowici is high and sandy, and never overflows. The lands in the vicinity of Darien are also high and do not overflow, so that the water is confined to an area bounded by the River Sandhills on the west and the high sandhills near Ludowici on the north and the high land of the coast on the south. This whole section is not overflowed, because the land is slightly rolling and the low parts only being covered to a depth of from one to eight feet. This overflow water can be cut off by building a low levee about three or four feet high along the south bank of Beard's Creek for about one and one half miles, and by stopping up the openings in the sandhills. This will require a levee 10 or 12 feet high for about 1,500 feet. This can probably be done for about 10 cents per yard, making the total cost very small, when considering the large number of acres that will be reclaimed.

NATURAL DRAINAGE CHANNELS

This section of the county that would be reclaimed is also the one most needing drainage. As stated above, the whole county is cut up by small swamps, but there are only two which can be used as main

drainage channels. These are Mortar and Jackey Camp Swamps. Mortar Swamp heads in Liberty County west of Tibet near the river sandhills, flowing in an easterly direction, and passing about two miles north of Townsend, 500 feet north of Darien Junction, and finally uniting with Bulltown Swamp to form the South Newport River. This swamp is not wide, above Darien Junction varying from 100 to 600 feet, and below widening out to half a mile. While the general direction is straight, the swamp itself is rather crooked. The other main drainage channel would run from this one through Jackey Camp Swamp. This swamp starts near Townsend and flows in a southeast direction, forming the Sapelo River at Eulonia. None of these swamps have a "run" of any size, and the whole being choked up by brush and fallen trees makes them inadequate to carry off the water, and in consequence there is water in them nearly all the time. Entering into these swamps are numerous other small swamps, through which laterals could be run, or laterals could be run as often as desired through the flat clay lands, thus making a complete system of drainage for the section. The canal through Mortar Swamp would be approximately twenty miles long and the Jackey Camp Canal about five miles long. This system would give thorough drainage channels for these lands. Another canal can possibly be run into the South Newport River through Bulltown Swamp, but it is not recommended at the present time.

SOIL AND FARMING CONDITIONS.

The soil is one of extreme fertility and capable of raising almost any crop. The top soil consists of a mixture of sand and light gray clay, the latter predominating. This is underlaid by a subsoil, 18 to 20 inches below the surface. The subsoil consists of thick, yellow clay, which will allow water to pass through very slowly. From this clay the Ludowici roofing tile is made. The mass when mixed, makes a very rich soil and one that is easily worked. The swamp soil consists of a mixture of black loam and clay, with a little sand, the whole being of light color. This is underlaid by a thick clay. The swamp

growth being mostly cypress, gum, ash, hickory, and a little maple, gives every indication of the fertility of the soil.

These lands are not farmed now to any extent on account of the overflow conditions and lack of drainage. Only the high knolls which are not covered by water are farmed, but those raise good crops. Notice was taken of the small gardens which show that these lands are well adapted to growing early garden truck.

The amount of drainage needed has been roughly given above, but it is thought that a very complete system would have to be laid out on account of the compact condition of the soil.

At the present time, while the natural conditions tend toward agriculture, it can not be called a farming country. The only farming done in the county is a little rice planting on the coast and a small amount of corn and sweet potatoes raised throughout the county. Along the main road from Darien to Eulonia, not as much as 10 acres of cultivated land were seen and hardly more than this from Darien to Barrington. The chief industries are working turpentine, lumber business, and cattle raising. The chief crops are sweet potatoes, rice, corn, sugar cane, cotton, and a little garden truck. Estimates as to crop yields per acre for this section are: cotton, one bale; corn, 50 bushels; sweet potatoes, 300 bushels.

TRANSPORTATION

The transportation facilities throughout the county are very good, there being two railroads, the main line of the Seaboard Air Line traversing the western section, and the Georgia Coast & Piedmont the central part. The main line of the Atlantic Coast Line runs through Liberty County near the McIntosh County line. The public roads in the county are, as a general rule, good hard roads, but there are some heavy sandy roads. Connections can also be made by water up the rivers. From Darien to Brunswick there is a daily service. As the products could be gotten to market easily and quickly, it is quite evident that this could be made a great trucking section.

OUTLOOK FOR DRAINAGE

The attitude of the landowners towards drainage is, on the whole, very favorable. A great deal of the land is owned in large tracts by private persons and lumber companies, and they manifested a great deal of enthusiasm on the subject. Most of the land has had all the large timber cut off and only a small, second growth now exists, which is worked for turpentine. This industry will in a few years run out and then there will be large tracts of land to put in condition to offer for sale. The present market value of these lands is from \$1.00 to \$3.00 per acre, and some has been bought recently for less. Judging from similar conditions and from small drained rice field lands, on the coast, I should say they would easily sell for from \$12 to \$20 per acre, when drained. If the trucking industry could be started here, the value of the lands would be greatly increased.

A drainage survey would have to be made from a camp, on account of the scarcity of farm houses throughout the district. All of the main swamps indicated above would have to be run out and the canals located. The main roads should be run out and the watershed determined. Numerous cross-sections would have to be run. There is not much brush anywhere except a little in the swamps, so not many axemen would be necessary. The three railroads (A. C. L., S. A. L., and G. C. & P.) are all affected by the high waters and the companies should be very much interested in the subject.

COAST SECTION OF THE COUNTY

Several of the largest farms on the coast were visited, being reached by buggy and train, and were given a personal inspection. The section is located on the Atlantic Ocean about 50 miles south of Savannah and 20 miles north of Brunswick. Darien, with a population of about 1,000 persons, is the only town of any size. Most of the investigations were conducted from this place. The country is for the most part high, sandy land with a gradual slope toward the ocean. It is cut up by many tidewater creeks and swamps which greatly facilitate drainage.

There is no main drainage channel in this section, but there are three rivers. The Altamaha, which is the largest, flows from the upper part of the State. The Sapelo and South Newport rivers can hardly be called more than tidewater creeks.

The soil is mostly sandy in the vicinity of Darien, with loam or clay in some places. Farther north, the soil changes to more of a light clay.

The farms are mostly well drained, for they have natural drainage, but in some instances this has been helped by the construction of small surface ditches emptying into tidewater.

The farming conditions in this section of the country are very simple and agriculture is practiced only to a small extent. There are three or four farms near Darien and some small ones in the north-eastern section of the county near the South Newport River. Fair crops seem to be raised, being mostly corn, sweet potatoes, and sugar cane.

The transportation facilities are very fair. Darien is connected with the other parts of the county by very good roads, one railroad—the Georgia Coast and Piedmont, which runs along this section of the coast—and by private boats through the inland creeks.

There are but few white men in this section and most of them have nice homes, which were at one time the centers of plantations, but agriculture now seems to be in a somewhat languishing condition.

There is very little drainage needed in this section, as most of the farms are well drained, but there is some swamp land in the locality that could be drained and put in condition to cultivate. A portion of this section which is in the "flat clay lands" will be included in the district to be formed there.

Telfair County¹

BY J. R. HASWELL

Assistant Drainage Engineer U. S. Department of Agriculture

DESCRIPTION

Telfair County is in the south-central part of Georgia. It is roughly diamond shaped with the short diagonal pointing north. The northwest boundary is a straight line dividing it from Dodge County. The northeast boundary is Gum Swamp, and the Ocmulgee River forms the irregular southern boundary.

The Seaboard Air Line Railway crosses the north corner of the county, and the Southern Railway passes from the north to the east corner. Steamboats make regular trips on the Ocmulgee River between Hawkinsville and Lumber City, and at certain seasons boats run as far up the river as Macon. This river navigation has delayed the building of a railroad through the southern part of the county. A lumber railroad extending west from Lumber City is now used to some extent for handling freight. Sand-clay roads are being built throughout the county, but as not enough attention is paid to maintenance, long stretches of sand beds are often met with.

The Soil Survey of Dodge County by the Bureau of Soils, U. S. Department of Agriculture, describes the topography as that of a gently rolling plain, cut by sluggish streams; and the same can be said of the north part of Telfair County. The land along the Ocmulgee is swampy and is frequently overflowed. In some places the overflowed land is several miles wide. Between the swamp and the high lands there are what are known as "second level" lands or "flat woods." The wet flats along the larger streams are also called "flat woods" but are not the same as the "second level" lands.

¹Field Examination made March, 1911.

FARMING CONDITIONS

This county has made great strides in the past few years in the way of improvements. This is best shown in the type of building used for homes. Mud and stick chimneys are fast going into disuse, glazed windows are becoming common, and some land owners are painting their houses, even those occupied by colored hired help. Woven wire fences are increasing rapidly, and higher grade cattle are being introduced.

The well-drained ridges are the favorite location for farms and as all the high land is not settled yet, the flats have remained almost untouched. A few persons have been attracted by the fertility of the flats and their freedom from washing in heavy rains, and have cleared and planted certain sections. When the clay subsoil has been near the surface, and the land properly managed, the money invested has brought large returns. At present only about one half of the 423 square miles in the county is cultivated, and of the uncultivated land, roughly one half is in timber suitable for lumbering. The farmers usually state their profit to be from 10 to 20 per cent. on the investment.

The majority of the owners live on their places and rent most of the land out to negroes. A few hire help and manage their own land. Settlers are coming into the State in large numbers and the large farms are being divided into smaller tracts. It is possible that a few of the farmers would cultivate some of their lands which might be reclaimed by drainage, but the greater part will probably have to be occupied by imported settlers.

SOIL

The soils in the county can be roughly divided into three classes, red pebbly land, sand, and muck.

The red pebbly land belongs to the Norfolk and Tifton series; the only readily distinguished difference between the two is that the Tifton sandy loam has more clay in the subsoil than the Norfolk, which results in a much stronger soil. The number of iron con-

cretions, or red pebbles, is usually taken as a measure of the fertility of the soil in this section. As the clay washes out of the topsoil more is brought up by the plow from the subsoil. The humus content is generally lower than it should be, because the continued exclusive use of commercial fertilizers has in many cases reduced the original store. The type of land in question is best adapted to corn and cotton. The Tifton sandy loam is one of the best cotton soils known.

Sand occurs in sandhills and in stream valleys. The sandhills are almost sterile and are of little use. The flats along the streams are for the most part composed of sand, with a little muck mixed in. Other formations show a layer of muck underlain by deep sand of a coarse texture, which is almost free from any organic matter. The combination of muck and sand has produced good corn crops when care was taken not to deplete the store of humus. When it has once gone down in fertility this soil is very hard to get back to productivity. It can not be built up as readily as some other formations and for this reason the drainage of the wet bottoms will naturally be delayed till the better soil is all taken up.

The greatest amount of humus is in the muck in the river swamp. This stretch of low land is technically speaking more overflow land than swamp. It contains a number of sloughs and ponds which have the richest land in them to be found in the county. Some farmers carry muck from the swamp and mix it with stable manure. The main part of the swamp is a fine silt loam which is far richer than any soil in the uplands. The erosion process which built up the swamp appears to take place as follows: The soil on the ridges is washed into the streams and the larger sand particles are deposited in the flat woods in the upper part of the watershed. The finer particles are carried down to the low lands and are deposited on the flats where the water is shallow and almost still. Thus the cream of the hills has been building up the low land for ages. A part of the swamp was cultivated before the Civil War and made good crops except in years when freshets drowned out the crops.

WATERSHEDS

The drainage from the entire county finally reaches the Ocmulgee River. What does not enter the Ocmulgee direct is carried there through the Little Ocmulgee River which is better known as Gum Swamp, the junction of the two streams being a little below Lumber City, at the eastern corner of the county. The combined drainage area of the Ocmulgee is about 6,000 square miles, of which 640 square miles drains into Gum Swamp. The divide between them starts at Lumber City and passes through Neilly and Milan, having a general northwesterly direction which can readily be seen from the map which accompanies this report.

The Big Ocmulgee receives the water from Big Horse Creek which is the largest stream within the county. Horse, Cat, and Alligator creeks are tributaries of the Big Horse, the total area of the watershed being 146.8 square miles of which 12.2 square miles are in Dodge County. A number of smaller streams drain into the river directly; of these McRae Branch is of note as a survey of its channel has been made by this Office, and it is proposed to construct a system of lateral drains to improve the flat woods draining into the branch.

The Little Ocmulgee River drains the upper part of the county chiefly by way of its tributaries, the most important of which is Sugar Creek whose watershed exclusive of Turnpike Creek contains 47.6 square miles in this county and 49.2 square miles in Dodge. Turnpike Creek is a branch of Sugar Creek and has a watershed containing 59.2 square miles in Telfair County and 18.0 square miles in Dodge. The stream channels in this watershed (Little Ocmulgee) are the worst in the county. A photograph is given of the condition of Gum Swamp about 21 miles above the junction with the Big Ocmulgee. When the lumbering interests were important in this section a channel was cut out through the swamp. Most of the work consisted in removing the overhanging trees and vines. There is little indication at present of any work ever having been done on the channel.

Lines of levels were run out to Gum Swamp from the U. S. Geological Survey's bench marks at McRae and Lumber City, and readings taken on the water surface. A line was also run to Sugar Creek. Bench marks Nos. 1 to 3, inclusive, were established. See descriptions at the end of this report. The leveling was done with a transit and the results should be close enough for a preliminary examination.

The distance between the bridges on Gum Swamp where the readings were taken is almost exactly 20 miles. The fall was found to be 84.9 feet, making 4.24 feet fall per mile. This is ample if the channel had a good cross-section.

Assuming a uniform fall in Gum Swamp, the fall in Sugar Creek between McRae and Gum Swamp is 94.7 feet. The distance is 17.5 miles, making a fall of 5.41 feet per mile.

The office of the Army Engineers at Brunswick, very kindly supplied some data which they had taken along the Ocnulgee River. Their data is given under bench marks at the end of this report. The results showed an average fall of 0.93 foot per mile between Jacksonville Ferry and McRae Branch. It will be of interest to note that a common saying in the locality is that one mile on land equals three on water. This is due to the fact that the trails are almost straight and the channel is very crooked. A few cut-offs would help the run-off very much and the possibilities of such can be seen on the map which accompanies this report. As the watershed is only a little over 30 miles wide and is about 175 miles long, the effect of a severe storm is not so great as if the shape resembled a fan.

RAINFALL AND RUN-OFF

The average annual rainfall in this section of the State is slightly above 50 inches. The maximum and minimum precipitation at Atlanta for the period investigated was 59.77 inches in 1901 and 33.13 inches in 1904. Atlanta is on the divide at the head of the stream and has about 3 inches greater average annual precipitation than the lower sections of the watershed. A list of storms of two inches and over in 24 hours is given for Atlanta, Macon, Eastman, and Hawkins-

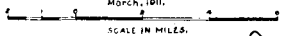
ville, from January, 1901, to June, 1909. These stations are located at favorable places in the watershed and give a good idea of flood conditions. A storm covering a large area, and of sufficient intensity to make the river overflow into the swamp, only comes every three or four years. The rest of the rain is fairly evenly distributed.

A gaging station of U. S. Geological Survey has been maintained at Macon since 1895. The factor showing the ratio of run-off to rainfall is irregular for periods of less than one year. The yearly coefficient is from .30 to .37 while the monthly value varies greatly. In dry spells the run-off may be greater than the rainfall and in wet months the coefficient goes as high as .70.

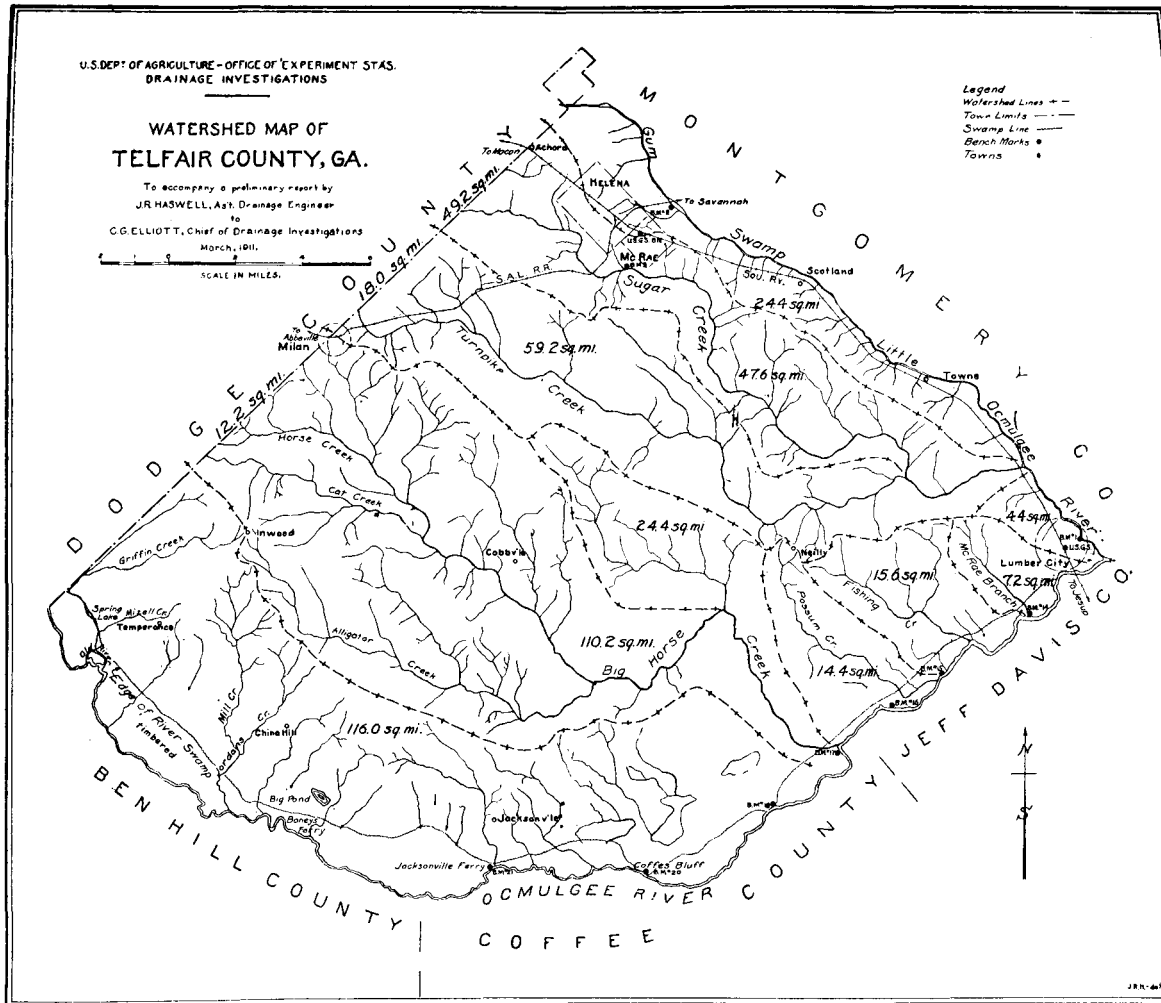
U.S. DEPT. OF AGRICULTURE - OFFICE OF EXPERIMENT STAS.
DRAINAGE INVESTIGATIONS

WATERSHED MAP OF TELFAIR COUNTY, GA.

To accompany a preliminary report by
J. R. HASWELL, Asst. Drainage Engineer
to
C. G. ELLIOTT, Chief of Drainage Investigations
March, 1911.



Legend
Watershed Lines ---
Town Limits - - -
Swamp Line - - -
Bench Marks ●
Towns *



MAP OF TELFAIR COUNTY

STORMS OF TWO INCHES AND OVER PER 24 HOURS FROM JANUARY, 1901 TO JUNE, 1909.

DATE	Inches of Rain in 24 Hours	STATION	DATE	Inches of Rain in 24 Hours	STATION
1901			1905		
Jan 11	2.37	Atlanta	Feb. 12	3 20	Hawkinsville
Feb. 3	2.58	Atlanta	Aug. 9	2 08	Eastman
Mch. 26	2.25	Atlanta	Dec. 2	4.60	Atlanta
Mch. 26	2.88	Macon	Dec. 8	2.00	Hawkinsville
Mch. 30	2.35	Hawkinsville	1906		
Apr. 13	2.56	Atlanta	Jan. 3	2.09	Atlanta
Apr. 2	2.45	Macon	Jan. 23	2.34	Macon
May 21	4.13	Atlanta	Mch. 14	2.50	Atlanta
May 21	2.04	Eastman	Mch. 19	2.49	Atlanta
June 12	2.15	Eastman	May 25	2.06	Atlanta
Aug. 22	3.66	Atlanta	June 12	3 01	Atlanta
Sept. 17	2.30	Atlanta	June 12	3 78	Macon
Sept. 18	2.28	Macon	June 5	3 63	Eastman
Sept. 18	2.10	Eastman	June 13	2 22	Eastman
Sept. 17	4.10	Hawkinsville	July 17	2.82	Atlanta
Dec. 29	2.99	Atlanta	July 19	2.17	Eastman
Dec. 14	2.20	Macon	Aug. 29	2.27	Eastman
1902			Oct. 1	2.56	Macon
Mch. 16	2.12	Macon	1907		
Mch. 14	2.05	Eastman	Feb. 4	2.01	Atlanta
Mch. 15	1.96	Eastman	Dec. 14	2.15	Eastman
Mch. 16	2.47	Eastman	Dec. 13	2.70	Hawkinsville
July 24	2.02	Macon	Dec. 22	2.20	Hawkinsville
July 12	2.12	Eastman	1908		
July 13	1.80	Eastman	Jan. 7	2.76	Eastman
July 14	2.06	Eastman	Jan. 7	2.35	Helena
July 15	1.25	Eastman	Feb. 1	3.52	Eastman
July 11	2.35	Hawkinsville	Mch. 23	3.72	Macon
July 12	1.43	Hawkinsville	Mch. 23	2.20	Eastman
Oct. 26	3.70	Hawkinsville	Mch. 24	2.91	Eastman
Dec. 16	2.20	Atlanta	Mch. 22	2.74	Hawkinsville
1903			Mch. 23	3.00	Hawkinsville
Feb. 7	2.45	Atlanta	Apr. 24	2.73	Atlanta
May 14	2.60	Hawkinsville	Apr. 14	2.16	Macon
June 4	2.41	Atlanta	Apr. 26	3 04	Macon
June 3	3.50	Hawkinsville	Apr. 15	2 07	Eastman
July 6	2.18	Macon	Apr. 23	3.18	Eastman
Aug. 1	3.60	Hawkinsville	July 5	2 31	Atlanta
Sept. 13	3.00	Hawkinsville	Aug. 25	2.82	Macon
1904			Sept. 5	2.61	Hawkinsville
Feb. 9	2 63	Hawkinsville	1909		
June 21	2.30	Hawkinsville	Jan. 63 (days)	4.18	Hawkinsville
July 24	2.35	Eastman	Feb. 9	2.11	Atlanta
Aug. 8	2.75	Atlanta	Feb. 9	3.67	Macon
Aug. 1	2.85	Eastman	Feb. 10	2.74	Hawkinsville
1905			Mch. 9	2.29	Atlanta
Feb. 12	3.61	Macon	Mch. 12	2.05	Atlanta
Feb. 12	2.92	Eastman	Mch. 21	4.20	Hawkinsville
Feb. 11	3.60	Hawkinsville			

TABLE SHOWING THE GREATEST RAINFALL IN 24 CONSECUTIVE HOURS IN GEORGIA FOR THE YEARS 1901-1909.

1901—Americus, September 17-18.....	8.80 inches
1902—Woodbury, February 27.....	9.18 "
1903—Thomasville, September 13-14.....	8.40 "
1904—Savannah, July 28-29.....	6.42 "
1905—St. Mary's, October 7.....	6.42 "
1906—Blakely, June 12.....	7.00 "
1907—Fleming, June 13.....	6.05 "
1908—Elberton, August 25.....	9.60 "
1909—Quitman, July 1-2.....	5.55 "

PROPOSED IMPROVEMENTS

The project which offers the greatest opportunities is the river swamp. A levee, pierced with sluices, is required with possibly back levees along Big Horse Creek. The average height would be only about seven feet. There are parts of Coffee Bluff which, so far as known, have never been under water, and at Jacksonville Landing the greatest known stage has only been about four feet above the banks. The level of the stream varies about thirteen feet between low and high water. At the time of the examination the water was low and was about six feet below normal. There is a hill on the south bank of the river at Cooper's Ferry which rises about 75 feet above the river. The only thing to compare with this on the Telfair side is a mound, a few miles above Jacksonville and several hundred yards from the river bank. Reports state that it contains about five acres and that it is 20 feet above high water. Indian pottery is said to have been found on it. The land back from the river is high enough to drain by gravity at ordinary stages but will have to have intercepting ditches to take off the surplus water in wet years. Some land along the edge of the swamp gives excellent returns except in wet seasons, and all that is needed is a ditch above it to make the crops certain. The swamp land would probably increase in value from about \$4 to \$100 per acre.

The next project in the order of magnitude is the "flat woods" in the lower part of the county. These are dry during most of the

year, but in wet seasons they are several feet under water. The deepening of stream channels and the opening of outlets for ponded places are all that are needed. Intercepting ditches on the uphill side of flats would be found to be of advantage, and tile drains through low places should give good results. The soil has been described under "sand" and contains a little muck. Where sand has been washed and forms considerable depth the practicability of expending large sums of money for improvements can be seriously questioned. There are about 40 square miles of "flat woods" in the county. The value of the land is about \$4 per acre but it would be worth about \$25 if drained.

The improvement of the smaller stream channels will open up a number of tracts of land on farms which are now occupied. Gum Swamp offers the greatest opportunity. From Lumber City up the channel is good for several miles, but from there on dredging is badly needed. The bridge over the swamp at McRae is 1,056 feet long and freshets spread to a much greater width.

Sugar Creek has a number of wet flats along it and would offer fair returns for improvements. The watershed is comparatively thickly settled, and also has the added advantage of being near the railroads. Good roads are also numerous. Turnpike Creek, a branch of Sugar Creek, does not offer as great inducements as the latter. It does not run through as good a section, particularly at its head. The soil is not so good and it is far inland.

Big Horse Creek has less overflowed land along it than the other streams. It is farther inland and is not near enough to the river to have an easy haul. It does not appear to be as large a project as those previously mentioned. The removal of trees and brush from the channel would be very beneficial. The same might be said of all the streams, but a dredged channel is needed on some to make a complete success.

The opportunity for the successful location of tile drains is one of the best in the State. There is enough fall to insure free operation, the soil is open, permitting a wide lateral drainage, and the

topography is such that long single lines will do the most good. Intercepting drains on the uphill side of bays and main lines in the bottoms of swales are what are most needed. The substitution of poles in the place of tile has been practiced. The quality of labor and the lack of proper supervision have resulted in failure to some of the pole drains. No tile has been used and there are few people in the county who can lay it. There are also very few leveling instruments, mostly cheap farm levels being used for terracing.

On the whole the people look upon drainage as an unnecessary expense. They have all the high land that they can manage and very little capital to work with.

APPENDIX

BENCH MARKS

No.	Elev. above mean sea.	DESCRIPTION.
1	112.84	On Little Ocmulgee River at Lumber City. South corner of new bridge one-half mile east of town, top of bolt on bearing plate anchorage. Top of bolt was 0.37 feet above concrete in steel tube abutment.
2	153.20	Gum Swamp at McRae. Road northeast from town, one mile out, north side; 120 feet southwest of bridge over swamp; R. R. spike set vertically in a four-foot pine tree, west side near ground.
3	205.40	Sugar Creek at McRae. East corner of bridge, one mile south of town. Water oak one foot in diameter 13 feet from bridge; R. R. spike driven horizontally into tree, four feet above ground on north side of tree.
BENCH MARKS ON OCMULGEE RIVER, SET BY WAR DEPARTMENT.		
14	103.53	"R. R. spike driven horizontally into base (one foot above ground) 28-inch red oak at McRae's Landing. Tree stands by side of road leading out from landing and is 185 feet from north bank of river; also is north 29 deg. 40 min. west, 181 feet from iron pipe, station No. 176, marked 'X.' 12.9 feet above local low water at bench mark. Mileage 15 5-20ths.
15	107.48	"R. R. spike driven horizontally into base of 12-inch white oak tree; 'X' cut in tree three feet above spike. Tree stands 100 feet from north bank of river at Slangleter's Bluff and is 630 feet above station 1149. 12 feet above local low water at bench mark. Mileage 20 3-20ths.

15-A	103.03	"X" cut in top of large boulder in edge of water, 10 feet from south bank of river near point about 300 feet above Berkett's Landing, 20 feet down-stream from station No. 1139.
16	109.13	6.5 feet above local low water at bench mark. Mileage 22. "R. R. spike horizontally in base 30-inch cypress at Dodges Old Boon Landing. Stands north 17° east 38' from station No. 1119 and 45' from north bank of river; marked 'X.'
17	112.94	8.8 feet above local low water at bench mark. Mileage 25. "R. R. spike in base 18-inch oak about one foot above ground. Tree stands 55 feet from bank of river on north side and is about 125 feet below station 1106. Mouth of Horse Creek about 1,000 feet below.
18	124.39	10.5 feet above local low water at bench mark. Mileage 27 15-20ths. "R. R. spike in base of 12-inch oak on Scuffle Bluff 150 feet from bank on upper end of bluff near wagon road 180 feet west of station No. 69 marked 'X.'
19	122.29	17.1 feet above local low water at bench mark. Mileage 34 4-20ths. "R. R. spike in base of 30-inch white oak about 1½ feet above ground, 65 feet from bank at Bear Lake Landing and south 64¾ feet east 141 feet from station No. 1046.
20	126.59	10.7 feet above local low water at bench mark. Mileage 38 12-20ths. "R. R. spike in 30-inch oak 1½ feet above ground, 40 feet from bank at upper end of Coffee Bluff Landing and 50 feet below slough, 135 feet west of station No. 1016, marked 'X.'
21	137.17	9.2 feet above local low water at bench mark. Mileage 43 15-20ths. "R. R. spike in base of 36-inch basket or post oak and two feet above ground, 161' north 19° 30' east of iron pipe, station No. 973 at Jacksonville Landing, 170' from river bank.
G.S.	145.478	13.2 feet above local low water at bench mark. Mileage 51 6-20ths."
G.S.	229.325	U. S. G. S. mark at Lumber City, 200 feet east of the Southern Ry. station, 52 feet north of the center of the main track, 26 feet southwest of corner of barber shop, and 3½ feet west of a chinaberry tree. U. S. G. S. mark at McRae, eight feet east of platform of old station, one foot east of the telegraph pole nearest the freight platform west of road at station, and 32 feet south of the center of the main track.

The Proposed Drainage Improvement of the McRae Branch, Telfair County

BY J. R. HASWELL,

Assistant Drainage Engineer U. S. Department of Agriculture

INTRODUCTION

In the latter part of February, 1910, the attention of the U. S. Department of Agriculture was called to some land in the lower part of Telfair County. A representative of the Bureau of Soils was sent to the farm of Judge Max L. McRae to make an examination of the soil in both the high and low parts of the farm. The low lands needed drainage more than anything else and the assistance of Drainage Investigations, Office of Experiment Stations, was therefore requested, so that plans could be made for their reclamation. Mr. J. V. Phillips, Assistant Drainage Engineer, made a preliminary examination of the low "flat woods" on August 2 and 3, 1910, and recommended that a survey be made. As Judge McRae stated that he was ready and willing to drain his land, the request for the survey was granted and J. R. Haswell, Assistant Drainage Engineer, was assigned to the work. After a talk with Judge McRae it was decided to stake out only enough lines to require a carload of tile. This tile work is the subject of another report. It was also decided not to stake out any ditches in the "flat woods" on account of the necessity of forming a drainage district and the lack of an adequate drainage law, under which to form the district. Enough data was secured for the area drained by McRae Branch to enable the drafting of plans and to serve as a basis for an estimate of cost.

¹January, 1911.

GEOGRAPHICAL LOCATION AND AREA

The McRae Branch is in the eastern part of Telfair County, two miles west of Lumber City. The Southern Railway crosses the county near its northeastern boundary and connects Lumber City with the Seaboard Air Line, via Helena.

The shape of the watershed is roughly a rectangle with the corners cut off, and it contains about 2,400 acres. The upper end is at the Lumber City road and the outlet is into the Big Ocmulgee River.

NATURAL DRAINAGE CHANNELS

The Branch extends through the middle of the watershed with numerous bays and prongs extending out to either side. The bays in the flat areas connect with each other in many instances without the water passing into the main channel. This gives a number of possible arrangements for drainage channels which will be discussed under "Plan Proposed for Drainage Improvement."

The size of the channel is variable. In places the water runs in a gully ten feet below the general surface of the country, and in others there is no channel at all. Some places were found where the channel had been built up higher than the land on the side. This was due to the choked condition of the stream, which caused the water to stand and deposit the sediment brought down from the higher cultivated land. The average fall in the channel is 0.5 feet per 100, so that if it were cleared out there would be little ditching required in the places where the bottom is far enough below the general surface. Where the stream has no deep water course it will be necessary to dig a ditch to sufficient depth to lower the ground water at least three feet in the farthest corner reached by the lateral drains.

Overflow conditions are serious most of the year except in the late fall and early winter. Practically the whole surface of the "flat woods" is wet. Over the greater part water stands from one to two feet in depth. There is generally a slight current, showing a flow toward the Branch, though the course is often very roundabout. Good drainage channels would soon remove this surface water.

Figure 8 shows the head of the bay southwest of Judge Max L. McRae's farm buildings. It has an elevation of 163.1 and is shown on the map. The bay is at the extreme left, its east edge being in the margin of the picture. The center of the picture shows a cotton field extending down to the "edge of flat woods" and at the right hand edge of the picture can be seen the main channel of McRae Branch. The thick timber is in the channel and the cut-off at the upper end of the main ditch runs through the scattered timber seen beyond the field.

NATURAL SURFACE CONDITIONS

The cleared areas are usually on ridges which slope down to bays or stream channels. The nearer the base of the ridge is approached the wetter the land becomes. The crests of the ridges are sometimes broad enough for a fair size field, but most of the cultivated land is on hillsides which wash readily. There is no terracing practiced. The river road is on a ridge for part of the distance shown on the map. The land adjacent to it is cultivated in some places. The cleared area at the head of McRae Branch which would not be benefited by proposed improvements is about 550 acres. Most of this is high land which is cultivated and the rest is stream channels which only need cleaning out in order to drain the seepy areas along them. There are less than 200 acres scattered in small plots in the neighborhood of the river road, which are cleared and high enough for cultivation. This would leave a remainder of 1,650 acres of "flat woods" which need better drainage channels.

CROPS AND LAND VALUES

The staple crop of this section is cotton, with an occasional field of corn. The cotton produces from one half to one 500-pound bale per acre and the corn from 13 to 30 bushels to the acre, depending upon the progressiveness of the farmer. Some oats and velvet beans are also grown. The gross value of the cotton crop is about \$40 per acre, while the other crops are usually fed to the farm animals. The

"flat woods" land can be bought for from \$1.00 to \$4.00 per acre. High land that is dry enough to cultivate and that is cleared will bring \$30 per acre.

SOIL

The soil has been treated of in the report made by Mr. H. H. Bennett, of the Bureau of Soils, and only a brief description is given here. The soil has been named the Tifton sandy loam. The sand content is about 80 per cent., with about 60 per cent. in the subsoil. It is said that the mechanical make-up is ideal for the crops grown but that the vegetable content is too low. This is very important in connection with drainage. The organic matter would cause the absorption by the soil of a greater proportion of the rainfall and would hold the moisture for the use of plants during dry spells.

DESCRIPTION OF SURVEY

A traverse line was run up the entire length of the main channel of McRae Branch, compass and stadia being used, and levels were taken with the level on the telescope of the transit. Junction points with bays, etc., were recorded, and where it was possible without the expenditure of too much time the length and direction of the branch channel were found.

The traverse line was connected to the lot corners of the squares into which this part of the state is divided. This division of the land is very irregular in the section covered. An actual survey had recently been made of the land owned by Judge McRae and concrete corner posts had been set. Readings were taken on most of these posts and the lot lines extended to cover the rest of the area. The river road was extended toward the west by making use of the new county map supplemented by pacing and a hand compass. The watershed lines were run in a similar manner. The mile posts are located as they were actually found and not as shown on the county map. The Ocmulgee River Lumber Company's tram railroad was located from the instrument traverse of the main channel and from the foot traverse of the west watershed line. The part of the line

near the middle of lot 230 was not located and is only shown on the map in order to connect the two parts actually surveyed. The road is only a temporary affair which will be removed as soon as the timber is exhausted.

A traverse line was run with the instrument across the lower edge of the cultivated land in order to connect the lot corners and also to get the elevations of the bay heads, which would give the fall in the stream channels. The party consisted of the engineer and a farm hand as rodman, when the instrument was used. A rodman was not necessary for foot traversing with a hand compass.

Bench-marks were set as per the list at the end of this report. These should be easily located on the ground and are accurately located on the map. They start with the U. S. Army Engineers' bench at the river, which elevation was assumed to be 100 feet. The others are all referred to this bench-mark.

The survey was made during what was said to be the longest cold snap in the last fifteen years. This put a limit on the amount of data secured. The rodman was not used to working in ice water, which made the work even harder. It was not desired to stake out the ditches, as the lumbering operations in progress would soon knock out the stakes. The location can easily be had from the following notes:

The outlet is at the junction of the main channel and the bay from the east, 1,500 feet below the log railroad. The ditch passes 50 feet southwest of "B. M.-3" and about 100 feet northeast of lot corner 229-230-239-240. The point whose elevation is 153.1, at the head of the tangent, is marked by a hub. The cut-off starts 120 feet west of lot corner 228-229-240-241 and discharges into the ditch at the head of the tangent. The above will aid in the location survey at the time of construction, when grade stakes should be set in order to get accurate dredging.

PLAN PROPOSED FOR DRAINAGE IMPROVEMENT

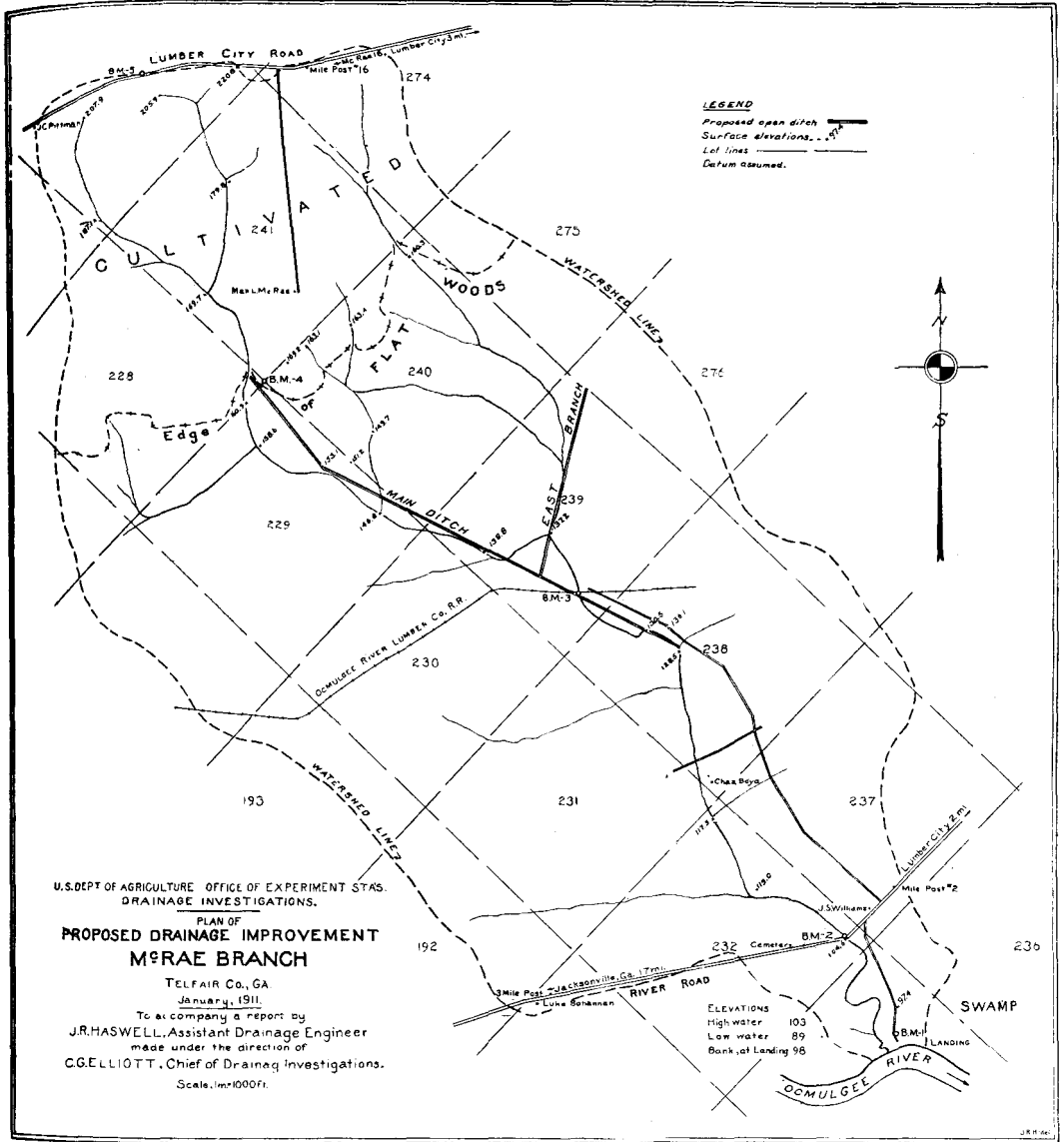
The object of constructing a drainage system is to make the lands under consideration dry enough for cultivation. This is done by lower-

ing the water table from the surface, where it now stands, to a depth suitable for plant growth; i. e., about two or three feet. In order to secure a wider possible spacing of lateral ditches they should be four feet deep.

It is proposed to start the main ditch a little to the west of the center of lot 238. From this point to the river the branch has a well defined channel with a good fall. The only improvement required would be to clean out the brush and trees which prevent the free passage of water.

The bottom of the ditch will be at the surface of the ground at the outlet and should be six feet deep at the junction of the East Branch. This depth will insure the drainage of the low ponds and the farthest corners reached by the lateral system. The track of the Ocmulgee River Lumber Company's lumber road is several feet above the general surface of the ground at the point where it crosses the proposed ditch, so that a culvert with its bottom at least seven feet below the top of the rails should be built. The exact elevation of the bottom can be had at the time of construction and should be such as will allow a true grade from the junction of the East Branch with the main ditch, to the outlet of the main ditch. This culvert should be large enough to take the heaviest storm without backing up the water; otherwise the crops on the flat fields would be drowned out.

The main ditch continues straight on from the junction with the East Branch for a distance of 3,470 feet, making a total length of 5,680 feet for the straight part of the channel. From the railroad to the end of the tangent there is no channel worth considering. From the railroad to the outlet the channel is well defined but is crooked and full of trees. The location as shown on the map will eliminate the crooks, do away with costly grubbing, and put the ditch on land which has practically the same elevation as the channel. The elevation of the junction of the two ditches above the railroad was not found during the survey. The land is so flat that an assumption of the elevation cannot be very far wrong. The value given in the table of data is believed to be within 0.3 of a foot of the actual elevation. The old channel, 600 feet northeast of



MAP OF McRAE VALLEY, TELFAIR COUNTY

the junction, is one foot lower than the junction, but a depth of six feet at the latter will provide a sufficient depth where the old channel is crossed by the East Branch near the center of lot 239.

At the end of the long tangent the main ditch turns toward the right and extends for 1,620 feet further, making a total length of 7,300 feet. This section of ditch is a cut-off across a bend in the channel. It connects a string of ponds which are below the level of the channel. Much less excavation will be required in this location and very little clearing off of timber will be necessary. The old channel is very thickly overgrown with timber and underbrush at this point.

The East Branch is shown extending over to lot 276. It is more than probable that complete data along the northeast water-shed line would show that the East Branch could be extended to reclaim land which now drains to the east into Gum Swamp.

There should be at least two lateral ditches about 1,000 feet apart, extending about northwest from the East Branch. These should be as straight as the land permits in that they should follow along the natural channels and low places except where this location would make undesirable crooks in the ditches.

There was no exact data obtainable for the area west of the channel. The gully, which is about 1,000 feet north of the river road, furnishes fair drainage for the land on either side. It is deep enough to serve as an outlet for small ditches of tile drains. If the upper end were cleared out it would serve as an outlet for a large ditch running near the lot line between Nos. 192 and 231. The length of this ditch would depend on the possibility of draining the land near the railroad. Observations made when the channel traverse and the water-shed lines were run would indicate that this location is possible and that on this line, with another ditch having a northwesterly direction up the middle of lot 230, would afford good drainage for this section.

The land north of the railroad and west of the ditch can be treated in several ways. The one plan easiest to handle would be to deepen the natural channel which diverges slightly from the railroad and starts

about 700 feet above the junction of the two ditches shown on the map. It should extend almost to the water-shed line, as it will act as an intercepting drain to remove the water that would seep out on to the land below. It would be well in this connection to throw the earth excavated on the down-hill side of the ditch, where it would act as a levee.

A ditch along the edge of the flat woods is necessary in order to take off the water which comes down from the higher, cultivated lands. The drainage of the land between this last ditch and the one north of the railroad is a problem which can only be worked out after much consideration of more data than was at hand when this report was written. There are several ridges in this area which could be cultivated after the two mentioned ditches are dug. The land between these ridges will need small ditches before it can be profitably worked.

This area west of the channel will be the last to be improved, so that it did not receive as much attention as the better located areas. Before any work is done it would be well to investigate the possibilities of a ditch along the southwest side of lots 229 and 230, possibly extending into lot 231 and discharging into the stream shown on the map.

A drainage coefficient of three fourths of an inch of water to be removed from the water-shed in 24 hours will give 30 square feet for the required cross-section of the main channel. As depth is the controlling factor in this case the carrying capacity of the ditch will be ample.

The method of construction will determine the size of the channel. The depth should be six feet for the greater part of the main ditch. Side slopes no steeper than one horizontal to one vertical should be used. The minimum width of bottom that can be constructed by farm labor is two feet, which makes a top width of 14 feet. This gives a cross-section of 48 square feet and 177 yards of excavation per 100 feet of ditch. At 25 cents per yard this would give a cost of \$44.25 per 100 feet.

If a small dipper dredge could be found with which to do the work it might be possible to lower the cost of hand labor. The cost of moving the machine from one job to another is so great that the whole area

draining into McRae Branch should be ditched at one time if a dredge is to be used. Even then it is doubtful if the work could be done much cheaper than by hand labor. The ordinary size dredge constructs a minimum ditch with a bottom width of 16 feet and a top width of 22 feet with side slopes of one-half to one with a depth of six feet. This minimum ditch has a cross-section of 114 square feet and requires 423 cubic yards of excavation per 100 feet of ditch. This minimum ditch would take up considerable land and would be harder to keep clean. The water flowing in it would have a much smaller velocity and would drop sediment in the ditch. A dredge could do the work for 10 cents per cubic yard, making the cost \$42.30 per 100 feet.

Hand work at 25 cents will be used in the estimate of cost, although the work should be done for less. Scrapers can be used for the first few feet of cut, but as soon as the footing gets difficult it will be impossible to use mules to pull the scrapers. There are few horses in the county. The digging of small ditches by dynamite has recently been tried with good success, so it is quite possible this might prove a cheap and effective method in this case.

As the lumber company is taking out the large timber the clearing problem will be very simple.

Work can be carried on at any season, except possibly November and December, when the water may not collect in sufficient quantities to float a dredge. If the work is done by hand winter is the best time, as there will be less water. The soil will dig readily at any season. There are neighborhood roads into Lumber City all along the line of work. Shipments are made up the lumber railroad at \$5.00 per car. The track is standard gage.

BENEFICIAL RESULTS

The proposed ditches will reclaim about 1,650 acres of land which is now practically useless except for scant pasturage. The land is rich in humus and gives every indication of producing abundant crops. Mosquitoes are a pest and come principally from these flat woods. Cases of malaria are very common. The drainage of this area under considera-

tion would not only make available a large tract of land for farming, but would also make the neighborhood far more healthful.

ESTIMATE OF COST

Main Ditch:

1,620 ft., below railroad, 74 cu. yds. per 100 feet, at 25c per yd.... \$ 300
 4,060 ft., average of 177 cu. yds. per 100 feet, at 25c. per cu. yd.... 1,797
 1,620 ft., above turn, average 129 cu. yds. per 100 ft., at 25c. per yd. 522

East Branch:

2,780 ft., average 150 cu. yds. per 100 ft., at 25c. per cu. yd..... 1,042

Total work shown on map..... \$3,661

Extensions to west:

2 miles ditch at \$2,300 per mile..... 4,600

Laterals to East Branch:

6,500 ft., averaging 100 cu. yds. per 100 ft., at 25c. per cu. yd..... 1,625

Total \$9,886

Average cost per acre, \$6.00, for the 1,650 acres of "flat woods" to be benefited, to which about 10 per cent. should be added for engineering during construction.

The unit prices are believed to be ample and the work should fall within the estimated cost. Similar scraper work in another section of the country cost 15 cents. It would be well to advertise for bids in contractors' journals as well as newspapers. Lower cost is usually had by doing the work privately, without recourse to law. This is possible if each property-owner will willingly pay his share of the cost.

DATA FOR MAIN DITCH

Sta. Feet	ELEVATIONS		Cut	Grade, ft. per 100	REMARKS
	Ground	Bottom Ditch			
0	128.5	128.5	0	*0.158	Gr. of outlet channel 0.44%
520	130.5	129.3	1.2		
1,620	135.4	131.1	4.3		B. M.-3
2,210	138.0	132.0	6.0	*0.435	Junction with East Branch
3,095	139.8	135.8	4.0		
5,680	153.1	147.1	6.0	*0.778	Turn toward right
7,300	163.7	159.7	4.0		In bay

* This indicates a break in the grade.



FIG. 2



FIG. 1.—CULTIVATED LANDS AT EDGE OF FLAT WOODS, MCRAE BRANCH, TELFAIR COUNTY, GEORGIA. BRANCH AT EXTREME RIGHT. OCMULGEE VALLEY IN BACKGROUND

PHOTOGRAPH BY J. R. HASWELL, 1911

FIG. 2.—MULBERRY RIVER BORDERING THE A. N. SMITH FARM, JACKSON COUNTY, GEORGIA, SHOWING NARROW STRAIGHT SECTION OF THE STREAM

PHOTOGRAPH BY C. G. ELLIOTT, 1908

LIST OF BENCH MARKS

No.	Elev.	DESCRIPTION.
1	100.00	Between branch and landing, 185 feet north of bank of Ocmulgee River, 2½-foot black oak standing alone, one foot up S. E. side of tree; railroad spike with lip pointing up. There is a large X mark cut four feet above the ground on the same side of the tree. This mark was set by the Army Engineers in the survey of the Altamaha River system, and is known as No. 14, McRæe's Landing. It has an elevation of — feet above sea level.
2	107.14	North side of River Road, east bank of McRæe Branch, three feet north of foot log; one-foot black gum tree blazed on east side, cut in root on east side.
3	135.37	Lumber railroad, at crossing of branch, 10 feet south of center line of track at curve; 18-inch cypress tree with notch in root on southeast side.
4	167.15	Stone corner between lots 228, 229, 240, 241, southwest of farm 1,000 feet below ford. On top of post.
5	225.74	North side of Lumber City Road, about midway between J. C. buildings of Max L. McRæe, east of McRæe Branch, about Pittman's residence and the McRæe farm lane, in front of new cottage, most westerly tree of row along road; one-foot black jack oak, spike in west side of tree near ground.

Drainage Plan for the Berry School Farm, Near Rome, Floyd County¹

BY L. L. HIDINGER

Assistant Drainage Engineer U. S. Department of Agriculture

INTRODUCTION

The Berry School, located one and one-half miles from the city of Rome, was founded by Miss Martha Berry for the purpose of instructing the boys of the mountain districts in the conduct of farm and other related work, so that when they return to their homes their influence will be exerted in the betterment of the poorer class of agricultural people. The school was started in a cottage and in six years has grown until now there are several dormitories, a large recitation hall, farm buildings and shops, and a domain of about one thousand acres of land. There are about 175 boys in the school, ranging in age between fourteen and twenty-five years. All are required to work two hours each day, their labor being so systematized that the entire domestic and farm work is performed by the boys of the school under the supervision of foremen who have charge of the several departments.

During the year Miss Berry, the founder and manager of the school, had conferred with the Secretary of the Department of Agriculture and with others in the same Department, regarding the work which is being done by the school and the need of advice and plans for the under-drainage of the farm. In accordance with Miss Berry's request, a preliminary examination was made November 4, and the survey was started November 9, 1908, for the purpose of locating and designing under-drains for the wet lands of the school.

¹Survey made 1908.

DRAINAGE

The Berry School Farm is located in what was originally termed the "Flat Woods." Its surface is a series of undulating slopes which were at one time a level plain, but which are now creased by a small valley with its drainage channel known as Dry Creek, and a number of swales or draws which form the natural water courses for the drainage of this and surrounding farms. The slopes of most of the land are not what could be termed steep, but the soil is so finely divided and of such a texture that gullies are of frequent occurrence where the water is allowed to concentrate and follow a low place for a considerable length of time. Where the water is compelled to spread over a broad surface, the ground is seldom injured. There are, however, some recently acquired fields at the back of the farm which are somewhat steep and whose slopes are depleted of fertility and gashed by gullies, due to a lack of judicious farming.

The parts of the farm needing drainage are the valley and swales, together with a few seepy places. These are naturally divided into four separate systems, and are listed accordingly.

The soil in the wet parts of the farm is naturally the most productive since it is built up of the lighter, more fertile particles that wash from the surrounding slopes. It is a dull gray, finely divided, closely compacted clay through which the water moves quite slowly. The underlying strata are yellow clay, gravel and limestone. In the low places "limestone sinks," that lead to underground passages for the water, are of frequent occurrence. In some instances these sinks are the only natural outlets from basins that would otherwise fill with water. Some of them will, as far as known, dispose of all the water that gets to them, and should in no instance be filled up with foreign matter.

SURVEYS.

Dry Creek was meandered and the meander line used as a base for the locations of all drains and fields. From Station 0 on the Dry Creek meander, a line was run up a swale to the front field where the tile of System No. 1 empties, and from there on up, the lengths of all lines of

tile were carefully measured and angles and magnetic bearings read, and such other field notes were taken as seemed necessary. Systems Nos. 2 and 3 were likewise carefully outlined and connected to the Dry Creek meander line. The swale between the point of discharge of System No. 3 and the creek was meandered. All three of these drainage systems were located for immediate work; stakes were set every 100 feet on the line, at each change in direction of the line, and at all junction points. System No. 4 was carefully outlined, with distances and angles measured, but only a few permanent stakes were set.

Levels were run over all tile lines, taking elevations every 100 feet. On the first three systems, elevations were taken to hundredths of a foot on top of the stakes, but on No. 4 all elevations were taken on the ground to tenths of a foot. Elevations were also obtained at frequent intervals over the entire farm and along Dry Creek. All levels were run with a standard size Gurley transit, but were checked so frequently that an error of any consequence was impossible.

Bench-marks were left at convenient points over the farm, all elevations being referred to an assumed datum. (See appended list.)

PLANS FOR IMPROVEMENT

The plans include a map and two profile sheets. The map shows all lines of tile with distances and sizes recorded for each line and branch line, the boundaries of fields, the location of roads and buildings, and the elevation of the ground at numerous points. The profiles show the grades, size of tile, depth of all lines of tile and the location of catch basins.

It will not be profitable to try to prevent the overflow of Dry Creek, since the lands adjacent are used for pasture and are not injured by a slight overflow, and also since the expense of deepening it would be prohibitive owing to the frequent occurrence of ledges of limestone that lie near the surface of the ground and appear to extend across the valley.

Drainage System No. 1, composed entirely of tile, lies in the front field and crosses the drive from the Summerville Road to the school buildings. Its outlet is in a swale at the edge of the timber, about 500

feet south of Recitation Hall. System No. 2, composed of an open ditch and lines of tile, lies between the dairy barn, Glenwood, and the hospital. The open ditch extends through the timber to the outlet of System No. 3, which lies between the Ridmond Gap Road, the Summerville Road, and the athletic field.

System No. 4 lies in the back field, known as the Gammon Farm, and is composed entirely of tile. One of the mains empties into Dry Creek and the other into a large "limestone sink," which has never been known to fill up with water. This tile will not be laid for some time, and careful observations are to be made by the school authorities as to the probability of the sink proving inadequate to care for the water delivered to it by Main No. 2. Should there be any question about it, the following changes are to be made. Main No. 1 shall be composed of 12-inch tile up to the junction of line B. The present line B (Main No. 1) shall be extended to the intersection of Main No. 2 and line B of Main No. 2, and shall be composed of 10-inch tile up to Station 6, and from Station 6 on up of 8-inch tile. Line A of Main No. 2 shall be connected with this 8-inch tile, and Main No. 2 shall not be constructed between the limestone sink and its junction with line B.

Owing to the condition and quality of the soil, it was considered advisable to lay the lines of tile 60 feet apart in the front field and 70 feet in the back field. The reason for laying them closer in the front field is the possibility of raising vegetables and other crops that require more drainage than do corn and small grains.

A run-off of one half-inch depth in 24 hours from the entire area drained, was allowed for in the design of sizes of tile, and catch basins were placed in all low places where the water collected and in the bottom of water-courses where gullies are liable to occur.

COST OF THE IMPROVEMENT

Since all the labor in the construction of the ditches, laying the tile, hauling, etc., will be done by the students, and all plans are furnished by the Department of Agriculture, the only cost to the school is the purchase price of the tile. This amounts to a total of \$558.39 (see list of

tile in Appendix A) and underdrains 45 acres of land at a cost per acre to the school of \$12.41. It is confidently expected that on the whole area underdrained the average returns from the land will be doubled and that the cost of the tile will be returned to the school by increased crops in two years of average rainfall or in one bad year.

GENERAL SPECIFICATIONS FOR CONSTRUCTING TILE DRAINS.

The lines for the ditches are indicated on the field by stakes which have been set by the engineer, and the depths and grades given by him shall constitute a part of these specifications.

Digging Trenches. The digging of each ditch must begin at its outlet, or at its junction with another tile drain, and proceed toward its upper end. The ditch must be dug along one side of survey stakes, and about ten inches distant from it, in a straight and neat manner, and the top soil thrown on one side of the ditch and the clay on the other. When a change in the direction of ditch is made it must be done by means of a neat curve, but in all cases the ditch must be kept near enough to the stakes so that they can be used in grading the bottom. In taking out the last draft, the blade of the spade must not go deeper than the proposed line, or bed upon which the tiles are to rest.

Grading the Bottom. The ditch must be dug to the depth indicated by the figures given with the survey, which depth is to be measured from the grade stakes which are not for that purpose, and graded evenly on the bottom by means of the "line and gage" method, or "target," or any other equally accurate device for obtaining an even and true bottom upon which to lay the tile. The bottom must be dressed with the tile hoe, or in case of large tiles, with the shovel, so that a groove will be made to receive the tile, and when laid in the ditch they will remain securely in place.

Laying the Tile. The laying of the tile must begin at the lower end and proceed up stream. The tile must be laid as closely as practicable, and in lines free from irregular crooks, the pieces being turned about until the upper edge closes, unless there is sand or fine silt which is likely to run into the tile, in which case the lower edge

must be laid close and the upper side covered with clay or other suitable material. When, in making turns, or by reason of irregular shaped tile, a crack of one fourth-inch or more is necessary left, it must be securely covered with broken pieces of tile. Junctions with branch lines must be carefully and securely made.

Blinding the Tile. After the tile have been laid and inspected by the person in charge of the work, they must be covered with clay to a depth of six inches, unless, in the judgment of the superintendent, the tile are sufficiently firm so that complete filling of the ditch may be made directly upon the tile. In no case must the tile be covered with sand without other material being first used.

The Line Method. This consists of setting a line or wire directly over the grade stakes at a given distance above the parallel to the bottom of the proposed ditch. As the bottom is finished for the tile it is tested by means of a gage which carries a light cross-bar sat at a right angle to it. The line is stretched parallel to the grade line of the ditch and five feet above it, which is a convenient height, and tested by the gage, which is five feet long from the bottom to cross-bar. The line should be supported at two or three points between stations to prevent sagging.

To set the line, subtract the depth of the ditch at a given station from the length of the gage to be used and set the line above the grade stake the amount of this difference. Then the distance below the hub, plus the distance above it to the line, equals the length of gage.

Another method of finding the point at which to set the line does away with all mental subtraction of figures and the errors which may arise from it. Take a stick the length of the proposed gage—in the above case five feet—and graduate it to inches and quarter inches, beginning at the top and numbering down. One-eighth inches can be obtained by estimation. To use the measure at any grade peg, note the cut or depth for that stake, find the same mark on the measure, set the bottom end of the measure upon the grade peg and bring the line to

this point. When the measure is placed upon any grade stake, the position for the line is at the mark corresponding to the depth at that stake.

CATCH BASINS OR INLETS

Catch basins or inlets shall be constructed, where indicated in the plans, by filling the trench for a distance of five feet with crushed rock, broken bricks, or cinders, the finest material to be placed immediately over the tile and the coarsest on top. A layer of cinders, one foot thick, immediately over the tile, with the remainder of the opening filled with crushed rock or brick, would make an ideal inlet. The surface of the ground should be sloped toward the inlets, to allow the water to reach them easily. In case the inlets become clogged with sediment, the material forming them should be removed and cleaned.

PROTECTION OF OUTLETS

The outlet of each line of tile should be protected so that the tile will not be undermined and washed out, and in such a way that animals cannot enter the tile when there is no water flowing. A box, not less than eight feet long, should be made of planks two inches thick and of such size that the end of the tile will enter it. This box should be carefully laid to grade and the earth should be securely tamped around it so that the water will not seep out along the outside and undermine it. The outer end should be protected by a substantial iron screen or by large galvanized iron wires secured in a vertical position about two inches apart.

ESTIMATE OF COST

Tile for Systems Nos. 1, 2 and 3:

13,835 feet 4-inch tile, at \$17.00 per 1,000 feet.....	\$235.20
1,210 feet 6-inch tile, at \$31.00 per 1,000 feet.....	37.50
6 4-inch on 6-inch Y's, at 20 cents each.....	1.20
22 4-inch on 4-inch Y's, at 15 cents each.....	3.30

————— \$277.20

Tile for System No. 4:

8,610 feet 4-inch tile, at \$17.00 per 1,000 feet.....	\$146.37
2,665 feet 6-inch tile, at \$31.00 per 1,000 feet.....	82.62
450 feet 8-inch tile, at \$75.00 per 1,000 feet.....	33.75
150 feet 10-inch tile, at \$90.00 per 1,000 feet.....	13.50
1 6-inch on 10-inch Y's.....	.25
1 4-inch on 10-inch Y's.....	.25
6 4-inch on 8-inch Y's, at 20 cents each.....	1.20
1 6-inch on 6-inch Y's.....	.20
10 4-inch on 6-inch Y's, at 20 cents each.....	2.00
7 4-inch on 4-inch Y's, at 15 cents each.....	1.05
	<hr/>
	\$281.19
Grand total.....	\$558.39

BENCH MARKS

	Elevation.
Cross (x) top S. W. corner concrete cap, N. end steps at west entrance to Recitation Hall.....	75.00
Nail in root of 12-inch oak, 15 feet N. W. Station 0, main line System No. 1.....	54.36
Nail in first post N. of ditch at Station 0, main line System No. 2..	42.73
Nail in 16-inch red oak, about 200 feet N. of negro cabin, about one-fourth mile N. of Glenwood.....	57.13

PERMANENT STAKES TO BE USED IN THE RE-LOCATION OF
SYSTEM NO. 4

Station 0 Main No. 1, old pick handle one-foot high, on bank of creek near fence corner.

Station 0+83.5, 2-inch x 3-inch oak stake 13.7 feet from fence corner.

Station 9+59.5, 2-inch x 2-inch oak stake.

Station 17+00, 2-inch x 2-inch oak stake.

South side limestone sink, 2-inch x 4-inch oak stake.

The Improvement of Mulberry River, Jackson County¹

BY L. L. HIDINGER

Assistant Drainage Engineer U. S. Department of Agriculture

LOCATION AND DESCRIPTION

The Mulberry River rises near Flowery Branch in Hall County, Georgia, and empties into the Oconee River. The part of the stream under consideration is about nine miles long, and lies near the town of Hoschton, which is on the Gainesville Midland Railway, between the Long bridge on the J. N. Thompson Company's land and the beginning of the Shoals, which are about three-quarters of a mile below the Hosch bridge.

The watershed of the Mulberry River consists of steep, almost precipitous hills and small valleys. In some places the hills are too steep to cultivate even with the aid of terraces; and even where the slope is less and terraces are used, considerable difficulty is experienced in constructing them strong enough to prevent the water breaking through and causing bad washes on the hill sides. The steepest hills are covered with a growth of pines except where the land has been recently cultivated but is now abandoned, and in such places it is usually overgrown with briars and full of washouts and gullies. The soil contains a large percentage of sand and disintegrating rock that washes very readily, and when these are carried along at a high velocity they cut and gully the surface very rapidly. The sand with which these streams are charged is deposited when the velocity is reduced, either by a flatter slope at the edge of the bottoms, or by the slower movement of a larger stream.

The valley is narrow, with a good slope longitudinally and a slope of one to two or even three feet away from the stream. The channel has been straightened more or less through the J. N. Thompson Company's

¹January, 1909.

and Braselton Brothers' lands, but below this it is quite crooked. Below the J. N. Thompson Company's land the banks are covered with a dense growth of cane and trees that hang over the channel and retard the flow of the water. In some places the bottom lands are gashed by ditches and sloughs scoured out by the flood waters which sweep down the valley with a high velocity. To prevent this scouring action, and also to cause a deposit and thus build up the land, some of the owners have allowed narrow strips of heavy cane to grow up across the bottoms.

The soil is a sandy silt loam that has been deposited by the overflows. It is reddish brown in color, and very fertile, as are all such soils. It is adapted to the growth of all crops raised in this section of the state, but will, in all probability, be planted largely to corn.

THE SURVEY

The survey was made during the latter part of December, 1908, and the first of January, 1909, by L. L. Hidinger, chief of party, and H. R. Elliott, assistant. A transit line was run from the Long bridge on the J. N. Thompson Company's land, to a point about three quarters of a mile below the Hosch bridge. This line was run along the bank of the stream, except that it crossed the bends approximately on the lines of the proposed cut-offs. Stakes were set every 200 feet on the line and at each instrument point; measurements were taken to the bank of the river at each stake, and all cut-offs, when not on the line, were carefully located with reference to it; a compass and stadia line was run along the edge of the valley, and all property lines were located in order that the area of overflowed land belonging to each owner might be obtained.

Levels were run over the transit line and checked back, and a few lines were run across the valley to determine the relative elevation of different parts of the flooded area. There were no sea-level elevations near, so an assumed datum was used. Two U. S. Drainage Survey bench marks were set, one at Thompson's bridge and one at Price's bridge.

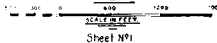
U.S. DEPARTMENT OF AGRICULTURE — OFFICE OF EXPERIMENT STATIONS

DRAINAGE INVESTIGATIONS
MAP OF
MULBERRY RIVER
GEORGIA

Prepared to accompany a report on the proposed improvements

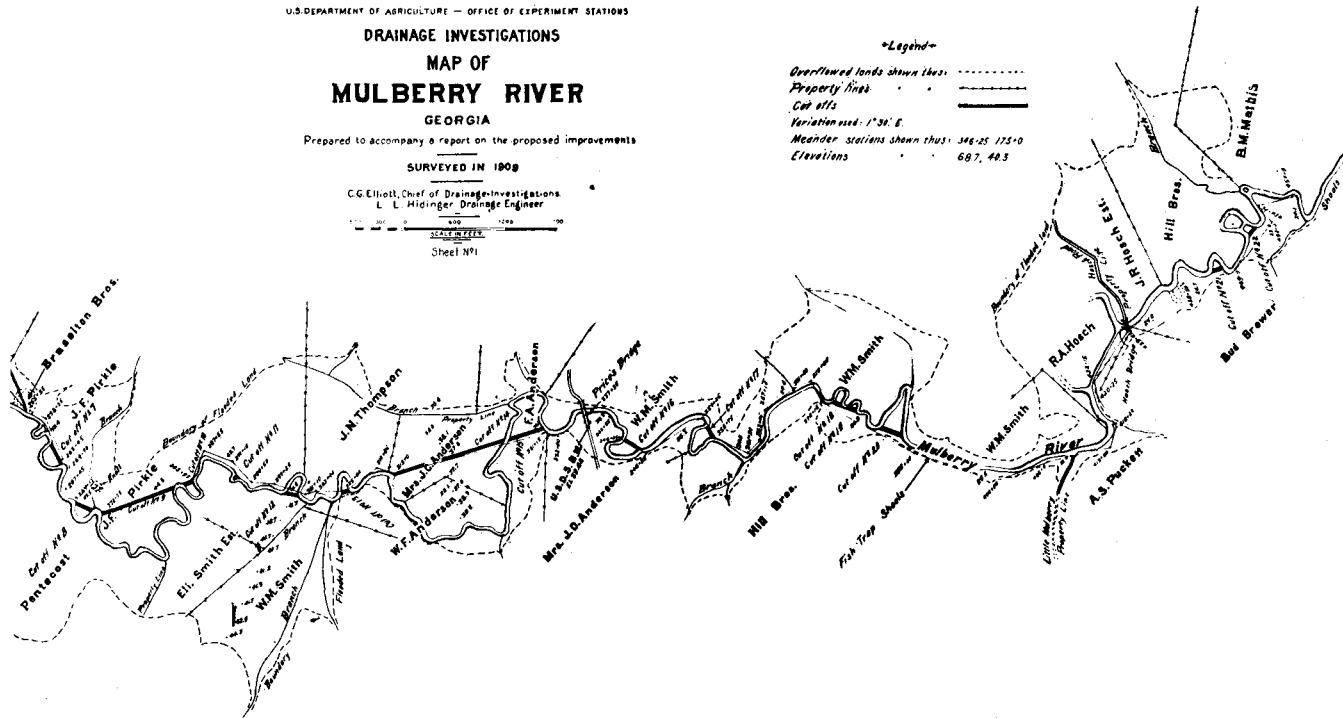
SURVEYED IN 1908

C.G. Elliott, Chief of Drainage Investigations
L. H. Hickingler, Drainage Engineer



Legend

Overflowed lands shown thus: - - - - -
Property lines: - - - - -
Cuts: ————
Variation used: 1' 30" E.
Meander stations shown thus: 348.25 175.0
Elevations: 687, 46.5



MAP OF LOWER PORTION OF MULBERRY RIVER, JACKSON COUNTY

The top and bottom widths, and the elevations of the bottom of the channel and of low water were obtained at each 200-foot stake, and the high-water elevations were taken wherever reliable marks could be found.

RESULTS OF THE SURVEY

The river channel is about 40 feet wide and from four to six feet deep down to the Fish Trap Shoals, and below this point is about 50 or 60 feet wide and eight to ten feet deep. Throughout its entire length there is a deposit of sand in the bottom of the channel from three to eight feet deep. At the Fish Trap Shoals a solid sheet of rock extends across the channel at a depth of four and a half feet below the bed of the stream and 11 feet below the banks, and from station 444 to the end of the survey rock was frequently encountered within one or two feet of the bottom of the channel. At station 462, where the survey was discontinued, there was a velocity sufficient to sweep all the sand off this rock and carry it over the rapids.

The largest tributaries to the river in this section are Cooper's Mill Creek, entering near station 49+50; Cronic Creek, entering near station 217+50, a creek without a name entering above station 331 from the northeast; Tugle's Mill Creek, entering near station 150+25, and Little Mulberry River, entering at station 409 from the west. Aside from these there are numerous small branches and sloughs entering the most of the tributaries below Cronic Creek cross the bottoms with a flat river on both sides. With the exception of the Little Mulberry River, grade and low velocity, and most of the sand is deposited before it reaches the river. Cronic Creek and nearly all the tributaries above deliver sand to the river in large quantities.

The area of overflowed land in the part of the valley investigated is 935 acres, of which 165 acres lie above and 770 acres below station 175, which is about half way across the A. N. Smith property. Of the 770 acres below this point, about 585 are cultivated with varying success, and 350 are too wet to cultivate. The following list gives the acreage of each landowner:

Owner.	Acres.
J. N. Thompson Company.....	148.0
J. W. Maddox.....	28.3
A. N. Smith.....	30.6
Braselton Brothers.....	152.4
J. F. Pirkle.....	74.8
Pentecost	63.8
Eli Smith estate.....	21.5
W. M. Smith.....	139.0
J. N. Thompson.....	34.5
W. F. A. Anderson.....	34.4
Mrs. J. C. Anderson.....	35.7
Hill Brothers.....	72.9
A. S. Puckett.....	5.0
Bud Brewer.....	16.1
R. A. Hosch.....	42.0
J. R. Hosch.....	27.0
B. M. Mathis.....	9.0
Total	935.0

PLANS AND ESTIMATES

Two sheets accompany this report. One of these is a map showing the channel of the river, the cut-offs recommended, the boundary of the flooded lands, the property lines, the names of the landowners, and occasional elevations throughout the length of the valley; the other is a profile showing the high-water line, the surface of the ground along the transit line, the bottom of the present channel, and the grades and bottom widths of the proposed channel.

It is considered essential that a channel not less than 10 feet in depth, 20 feet in bottom width, and with side slopes of one to one, be constructed. This depth is necessary to give an outlet for all parts of the valley, and such a channel will give a velocity sufficiently high to carry the silt and sand brought down by the tributaries.

All cut-offs recommended should be constructed, as not only a greater velocity and smoother channel will be obtained, but there will be less material to be moved in each instance than by improving the present channel.

A bottom width of 20 feet above the mouth of the Little Mulberry,

and 35 feet below this junction, with side slopes of one to one throughout, will give a velocity high enough and nearly enough uniform to keep itself clean and discharge the sand brought to it into the swift water at the shoals.

It is not expected that such a channel will entirely prevent the overflow of the bottoms during the heavy winter rains, but that it will give ample depth for such drainage of the land as may be necessary, and will remove flood water in time to prevent serious injury to crops.

As much sand as possible should be kept from entering the river, by allowing it to deposit in the branches before reaching the main stream. If a branch flows through the valley for any considerable distance the sand is usually deposited at the point where the grade changes from a steep to a flat slope, which is generally at the foot of the hill. In nearly every case the smaller branches fill their channels at the foot of the hills and then spread over the bottoms, making an unproductive, unhealthy swamp. To remedy this an enlarged place should be excavated in the channel where the grade lessens; into this the sand will settle, from whence it can be pulled out, after every freshet if necessary, by a slip scraper and a pair of mules.

In the following estimates the upper 175 stations (about three and one third miles) are not included, since the cost of the improvement of that part of the stream is too great for the number of acres benefited, as is shown by the following rough estimate:

Total excavation, 17,500 linear feet=62,000 cubic yards (approximately):	
Cut 20 feet bottom width, 4 feet deep, side slopes 1 to 1. Cost of excavation, 62,000 yards at 9 cents.....	\$5,580
Legal and engineering expenses at 10 per cent.....	558
Total cost.....	\$6,138

Acres benefited, 165.

Average cost per acre, \$37.30.

The following estimate of the cost of improving the channel below station 175 is based on the usual contract prices for work of this kind and quantity:

Excavation, 172,000 cubic yards, at 9 cents.....	\$15,480
Bridges removed and replaced, two, at \$100.....	200
	<hr/>
	\$15,680
Engineering and legal expenses, 10 per cent.....	1,568
	<hr/>
Total cost.....	\$17,248
Acres benefited, 770.	
Average cost per acre, \$22.40.	

No allowance has been made for clearing, as there are very few trees and all cane and weeds can be swept down by the dipper of the dredge. It will be necessary to clear all trees from a right-of-way 100 feet wide to give ample room for the boom to swing the dipper. The landowners should either give the contractor the cord-wood obtained for clearing the right-of-way, or else clear it themselves and sell him the wood. In either case the wood should pay for the clearing.

Price's bridge is high enough for a dredge to pass under without dismantling, but the Braselton and Hosch bridges will have to be removed and then replaced when the dredge has passed. Both are in bad condition and part of the cost of replacing and repairing should be borne by the county.

At the suggestion of Mr. Henry Braselton the following explanations and estimates are submitted:

The work should be done by a 1 to 1 1/4-yard floating dipper dredge, moving down stream. A barge 65 feet long, 22 feet wide, and 6 feet deep, with vertical side spuds and trailing rear spuds, should be erected, and suitable machinery to operate a one-yard dipper on a 45-foot boom be installed. Such a machine should excavate from 400 to 500 cubic yards of earth in a day of one shift, and should not cost more than \$8,000. The force necessary to run such a machine will be one engineer, who will superintend the work, one craneman, one fireman and one deckhand. It should be remembered that operating a dredge is like any other business, some men succeed where others fail. It will be necessary to have an efficient, energetic superintendent who thoroughly understands the dredging business, or satisfactory results will not be obtained. The drainage organization can not expect to operate a dredge as cheaply



FIG. 2



FIG. 1.—MULBERRY RIVER, A. N. SMITH FARM, JACKSON COUNTY, GEORGIA,
SHOWING FORMATION OF SAND BAR AT BEND OF STREAM
PHOTOGRAPH BY C. G. ELLIOTT, 1908

FIG. 2.—FARM HOUSE ON HILL LAND BORDERING THE MULBERRY RIVER,
JACKSON COUNTY, GEORGIA
PHOTOGRAPH BY C. G. ELLIOTT, 1908

as an experienced contractor with a force of experienced men, and will, therefore, not be able to save all of a contractor's profit. At the completion of the work the dredge should sell for 60 per cent. of the first cost, or \$4,800, making the net cost to the district \$3,200.

Cost of operating dredge for one day, one shift:

1 Engineer and superintendent.....	\$ 4.00
1 Craneman	2.50
1 Fireman	1.25
1 Deckhand	1.25
3 Cords wood, at 75 cents.....	2.25
Oil and repairs.....	1.00
	\$12.25

At 400 yards per day, this is 3.1 cents per yard.

ESTIMATE OF COST

Excavation, 172,000 cubic yards, at 3.1 cents.....	\$ 5,332
Net cost of dredge.....	3,200
Interest on \$8,000, 1¾ years, at 6 per cent.....	840
Two bridges moved and replaced at \$100.....	200
	\$ 9,572
25 per cent. to cover risk.....	2,393
	\$11,965
Engineering and legal expenses.....	1,550
	\$13,515
Total cost.....	
Acres benefited, 770.	
Average cost per acre, \$17.56.	

This estimate is liberal and should cover the cost if efficient men and machinery are secured. The difference between this price and a contractor's price is about the usual profit expected on such work.

RECOMMENDATIONS

Taking into account the density of population and present value of land in this vicinity, it is not recommended that an improvement so costly be undertaken at this time. In some places it has been found profitable to protect from overflow land no more fertile than that along the Mulberry River at a cost of \$30 per acre, but in such instances the drained land in the vicinity has had a value considerably greater than

that in the section considered in this report. However, the property owners may decide at some future time to improve the stream, when land values here have increased and more of the bottoms have been abandoned; therefore, this report and the plans have been prepared with as great care as if the report were favorable and these recommendations should be followed when any improvements are undertaken.

Although it is not considered advisable to dredge out the river at the present time, it is strongly recommended that all drifts and obstructions be removed from the channel, and that all cane, brush and leaning trees be cleared from the bank of the stream. In this way the carrying capacity of the channel will be increased 20 to 30 per cent, and the benefit from this will be well worth the cost.

BENCH MARKS

Elevation.	DESCRIPTION
99.51	On southwest cornerstone abutment at north end of Long's Bridge.
69.76	U. S. Drainage Survey permanent bench mark at southeast end of middle pier Thompson's Bridge, stamped 69.8.
52.76	Nail in 6-inch ash at station 250+73 (60 feet from river).
39.66	U. S. Drainage Survey permanent bench mark at south side west end of Price's Bridge, stamped 39.7.
26.87	Nail in root of large tree on south bank Little Mulberry, 30 feet above mouth.
27.31	Nail in root of 15-inch oak on slope of bluff at end of line.

APPENDIX

Proposed Drainage Law¹

A Bill to be Entitled "An Act to promote the public health, convenience and welfare by leveeing, ditching and draining the wet, swamp, and overflowed lands of the state, and providing for the establishment of levee or drainage districts for the purpose of enlarging or changing any natural water-courses, and for digging ditches or canals for securing better drainage or providing better outlets for drainage; for building levees or embankments, and installing tide-gates or pumping plants for the reclamation of overflowed lands, and prescribing a method for so doing; and providing for the assessment and collection of the cost and expense of the same, and issuing and selling bonds therefor, and for the care and maintenance of such improvements when constructed, and for other purposes."

The General Assembly of Georgia Do Enact:

SECTION 1. The Clerk of the Superior Court together with the Board of Commissioners of Roads and Revenues, or if there be no such board, with the Ordinary of any County of the State of Georgia, shall constitute a court to have jurisdiction, power and authority to establish a levee or drainage district or districts in his county, and to locate and establish levees, drains or canals, and cause to be constructed, straightened, widened or deepened any ditch, drain, or water course, and to build levees or embankments and erect tide gates and pumping plants for the purpose of draining and reclaiming wet, swamp or overflowed lands; and it is hereby declared that the drainage of swamps and the drainage of the surface water from agricultural lands and the reclamation of tidal marshes shall be considered a public benefit and conducive to the public health, convenience, utility and welfare.

¹This drainage bill was prepared by the Legislative Committee of the Georgia Drainage Congress.

SEC. 2. Whenever a petition signed by a majority of the resident landowners in a proposed drainage district or by the owners of three-fifths of all the land which shall be affected by or assessed for the expense of the proposed improvements shall be filed in the office of the Clerk of the Superior Court of any County in which a part of said lands are located, setting forth that any specific body or district of land in the county and adjoining counties, described in such a way as to convey an intelligent idea as to the location of such land, is subject to overflow or too wet for cultivation, and the public benefit or utility or the public health, convenience or welfare will be promoted by draining, ditching or leveeing the same or by changing or improving the natural water courses, and setting forth therein as far as practicable, the starting point, route and terminus and lateral branches, if necessary, of the proposed improvement, signed by two or more sureties or by some lawful and authorized surety company, to be approved by the Clerk of the Superior Court and conditioned for the payment of all costs and expenses incurred in the proceedings in case the court does not grant the prayer of said petition, the said Clerk shall issue a summons to be served on all the defendant landowners who have not joined in the petition and whose lands are included in the proposed drainage district. Upon the return day the said Court shall appoint a disinterested and competent civil and drainage engineer and two resident freeholders of the county or counties in which said lands are located as a board of viewers to examine the lands described in the petition and make a preliminary report thereon. The compensation for the services of said engineer, his assistants and freeholders, shall be paid from such funds as may be specifically appointed for said express purpose, the same to be refunded when the drainage fund is subsequently provided by the sale of bonds, or otherwise. When the lands proposed to be drained and created into a drainage district are located in two or more counties the Clerk of the Superior Court, together with the Board of Commissioners of Roads and Revenues, or if there be no such Board, with the Ordinary of either county, the court as hereinbefore pro-

vided shall have and exercise the jurisdiction herein conferred, and the venue shall be in the County in which the petition is filed. The law and rules regulating civil proceedings shall be applicable to this act, so far as may be practicable. The summons may be served by publication as to any defendant who can not be personally served as provided by law.

SEC. 3. The board of viewers shall proceed to examine the land described in said petition, and other land if necessary to locate properly such improvement or improvements as are petitioned for, along the route described in the petition, or any other route answering the same purpose if found more practicable or feasible, and may make surveys such as may be necessary to determine the boundaries and elevation of the several parts of the district, and shall make and return to the Clerk of the Superior Court within thirty days, unless the time shall be extended by the court, a written report which shall set forth:

1. Whether the proposed drainage is practicable or not.
2. Whether it will benefit the public health or any public highway or be conducive to the general welfare of the community.
3. Whether the improvement proposed will benefit the lands sought to be benefited.
4. Whether or not all the lands that are benefited are included in the proposed drainage district.

They shall also file with this report a map of the proposed drainage district, showing the location of the ditch or ditches or other improvements to be constructed and the lands that will be affected thereby, and such other information as they may have collected that will tend to show the correctness of their findings.

SEC. 4. The Court aforesaid shall consider this report. If the viewers report that the drainage is not practicable or that it will not benefit the public health or any public highway or be conducive to the general welfare of the community, and the Court shall approve

such findings, the petition shall be dismissed at the cost of the petitioners. Such petition or proceeding may again be instituted by the same or additional land-owners at any time after six months, upon proper allegations that conditions have changed or that material facts were omitted or overlooked. If the viewers report that the drainage is practicable and that it will benefit the public health or any public highway or be conducive to the general welfare of the community, and the court shall so find, then the court shall fix a day when the report will be further heard and considered.

SEC. 5. If the petition is entertained by the court, notice shall be given by publication for two consecutive weeks in some newspaper of general circulation within the county or counties, if one shall be published in such counties, and also by posting a written or printed notice at the door of the court house and at five conspicuous places within the drainage district that on the date set, naming the day, the court will consider and pass upon the report of the viewers. At least fifteen days shall intervene between the date of the publication and the posting of the notices and the date set for the hearing.

SEC. 6. At the date appointed for the hearing the court shall hear and determine any objections that may be offered to the report of the viewers. If it appear that there is any land within the proposed levee or drainage district that will not be affected by the leveeing or drainage thereof, such lands shall be excluded and the names of the owners withdrawn from such proceeding; and if it shall be shown that there is any land not within the proposed district that will be affected by the construction of the proposed levee or drain, the boundary of the district shall be so changed as to include such land, and such additional landowners shall be made parties plaintiff or defendant, respectively, and summons shall issue accordingly, as herein provided. After such change in the boundary is made, the sufficiency of the petition shall be verified, to determine whether or not it conforms to the requirements of the statute as provided in section two. The efficiency of the drainage or levees may also be

determined, and if it appears that the location of any levee or drain can be changed so as to make it more effective, or that other branches or spurs should be constructed, or that any branch or spur projected may be eliminated or other changes made that will tend to increase the benefits of the proposed work, such modification and changes shall be made by the board. The engineer and the other two viewers may attend this meeting and give any information or evidence that may be sought to verify and substantiate their report. If necessary, the petition, as amended, shall be referred by the court to the engineer and two viewers for further report. The above facts having been determined to the satisfaction of the court, and the boundaries of the proposed district so determined, it shall declare the establishment of the drainage or levee district, which shall be designated by a name or number, for the object and purpose as herein set forth.

SEC. 7. If it shall be necessary to acquire a right of way or an outlet over and through lands not affected by the drainage and the same can not be acquired by donation or purchase, then and in such event the power of eminent domain is hereby conferred, and the same may be condemned. Such owner or owners of the land proposed to be condemned may be made parties defendant in the manner of an ancillary proceeding, and the proceeding shall be substantially as provided for the condemnation of rights of way for railroads in chapter 9, of the Code of 1911, so far as the same may be applicable and such damages as may be awarded as compensation shall be paid by the board of drainage commissioners out of the first funds which shall be available from the proceeds of sale of bonds or otherwise.

SEC. 8. Any person or corporation owning lands within the drainage or levee district which he or it thinks will not be benefited by the improvement and should not be included in the district may appeal from the decision of the court to the Superior Court of such county, by filing an appeal, accompanied by a bond conditioned for the payment of the costs, if the appeal should be decided against him, for such sum as the court may require, not exceeding two hundred

dollars, signed by two or more solvent sureties, or in some approved surety company, to be approved by the court.

SEC. 9. After the district is established the court shall refer the report of the engineer and viewers back to them to make a complete survey, plans and specifications for the drains or levees or other improvements, and fix a time when said engineer and viewers shall complete and file their report, not exceeding sixty days.

SEC. 10. The engineer and viewers shall have power to employ such assistants as may be necessary to make a complete survey of the drainage district, and shall enter upon the ground and make a survey of the main drain or drains and all its lateral. The line of each ditch, drain or levee shall be plainly and substantially marked on the ground. The course and distance of each ditch shall be carefully noted and sufficient notes made, so that it may be accurately platted and mapped. A line of levels shall be run for the entire work and sufficient data secured from which accurate profiles and plans may be made. Frequent bench marks shall be established along the line, on permanent objects, and their elevation recorded in the field books. If it is deemed expedient by the engineer and viewers, other levels may be run to determine the fall from one part of the district to another. If an old water course, ditch or channel is being widened, deepened or straightened, it shall be accurately cross-sectioned, so as to compute the amount of cubic yards saved by the use of such old channel. A drainage map of the district shall then be completed, showing the location of the ditch or ditches and other improvements and the boundary, as closely as may be determined by the records of the lands owned by each individual landowner within the district. The location of any railroads or public highways and the boundary of any incorporated towns or villages within the district shall be shown on the map. There shall also be prepared to accompany this map a profile of each levee, drain or water course, showing the surface of the ground, the bottom or grade of the proposed improvement and the number of cubic yards of excavation or

fill in each mile or fraction thereof, and the total yards in the proposed improvement and the estimated cost thereof, and plans and specifications, and the cost of any other work required to be done.

SEC. 11. It shall be the further duty of the engineer and viewers to assess the damages claimed by any one that is justly right and due to them for land taken or for inconvenience imposed because of the construction of the improvement, or for any other legal damages sustained. Such damage shall be considered separate and apart from any benefit the land would receive because of the proposed work, and shall be paid by the board of drainage commissioners when funds shall come into their hands.

SEC. 12. It shall be the further duty of the engineer and viewers to personally examine the land in the district and classify it with reference to the benefit it will receive from the construction of the levee, ditch or water course or other improvement. In case of drainage, the degree of wetness of the land, its proximity to the ditch or a natural outlet and the fertility of the soil shall be considered in determining the amount of benefit it will receive by the construction of the ditch. The land benefited shall be separated in five classes. The land receiving the highest benefit shall be marked "Class A;" that receiving the next highest benefit "Class B;" that receiving the next highest benefit, "Class C;" that receiving the next highest benefit, "Class D," and that receiving the smallest benefit, "Class E." The holdings of any one landowner need not necessarily be all in one class, but the number of acres in each class shall be ascertained, though its boundary need not be marked on the ground or shown on the map. The total number of acres owned by one person in each class and the total number of acres benefited shall be determined. The total number of acres of each class in the entire district shall be obtained and presented in tabulated form. The scale of assessment upon the several classes of land returned by the engineer and viewers shall be in the ratio of five, four, three, two and one; that is to say, as often as five mills per acre is assessed against the land in "Class

A," four mills per acre shall be assessed against the land in "Class B," three mills per acre in "Class C," two mills per acre in "Class D" and one mill per acre in "Class E." This shall form the basis of the assessment of benefits to the lands for drainage purposes.

SEC. 13. The engineer and viewers shall keep an accurate account and report to the court the name and number of days each person was employed on the survey and the kind of work he was doing and any expenses that may have been incurred in going to and from the work, and the cost of any supplies or material that may have been used in making the survey.

SEC. 14. In case the work is delayed by high water, sickness or any other good cause, and the report is not completed at the time fixed by the court, the engineer and viewers shall appear before the court and state in writing the cause of such failure and ask for sufficient time in which to complete the work, and the court shall set another date by which the report shall be completed and filed.

SEC. 15. When the final report is completed and filed it shall be examined by the court, and if it is found to be in due form and in accordance with the law it shall be accepted, and if not in due form it may be referred back to the engineer and viewers, with instructions to secure further information, to be reported at a subsequent date to be fixed by the court. When the report is fully completed and accepted by the court a date not less than twenty days thereafter shall be fixed by the court for the final hearing upon the report, and notice thereof shall be given by publication in a newspaper of general circulation in the county and by posting a written or printed notice on the door of the court house and at five conspicuous places throughout the district, such publication to be made for at least two weeks before the final hearing. During this time a copy of the report shall be on file in the office of the clerk of the Superior Court and shall be open to the inspection of any landowner or other person interested within the district.

SEC. 16. At the date set for hearing any landowner may appear in person or by counsel and file his objection in writing to the report of the viewers; and it shall be the duty of the court to carefully review the report of the viewers and the objection filed thereto, and make such changes as are necessary to render substantial and equal justice to all the landowners in the district. If, in the opinion of the court, the cost of construction, together with the amount of damages assessed, is not greater than the benefits that will accrue to the land affected, the court shall confirm the report of the viewers. If, however, the court finds that the cost of construction, together with the damages assessed, is greater than the resulting benefit that will accrue to the lands affected, the court shall dismiss the proceedings at the cost of the petitioners, and the sureties upon the bond so filed by them shall be liable for such costs; and the court may from time to time collect from the petitioners such amounts as may be necessary to pay accrued costs.

SEC. 17. Any party aggrieved may within ten days after the confirmation of the assessors' report, appeal to the Superior Court. Such appeal shall be taken and prosecuted as now provided in civil proceedings.

SEC. 18. The Clerk of the Superior Court shall provide a suitable book, to be known as the "Drainage Record," in which he shall transcribe every petition, motion, order, report, judgment or finding of the board in every drainage transaction that may come before it, in such a manner as to make a complete and continuous record of the case. Copies of all the maps and profiles are to be furnished by the engineer and marked by the Clerk "official copies," which shall be kept on file by him in his office, and one other copy shall be pasted or otherwise attached to his record book.

SEC. 19. After the said drainage district shall have been declared established, as aforesaid, and the survey and plan therefor approved, the court shall appoint three persons, who shall be designated as the board of drainage commissioners. Such drainage commissioners

shall first be elected by the owners of land within the drainage or levee district, or by a majority of same, in such manner as the court shall prescribe. The court shall appoint those receiving a majority of the votes. If any one or more of such proposed commissioners shall not receive the vote of a majority of such landowners the court shall appoint all or the remainder from among those voted for in the election. Any vacancy thereafter occurring shall be filled in like manner. Such three drainage commissioners, when so appointed, shall be immediately created a body corporate under the name and style of "The Board of Drainage Commissioners of District," with the right to hold property and convey the same, to sue and be sued, and shall possess such other powers as usually pertain to corporations. They shall organize by electing from among their number a chairman and a vice-chairman. They shall also elect a secretary, either within or without their body. The treasurer of the county in which the proceeding was instituted shall be ex officio treasurer of such drainage commissioners. Such board of drainage commissioners shall adopt a seal, which they may alter at pleasure. The board of drainage commissioners shall have and possess such powers as are herein granted. The name of such drainage district, whether designated by number or otherwise, shall constitute a part of its corporate name; for illustration, "The Board of Drainage Commissioners of (No. 1 or Okefinokee) District."

SEC. 20. The board of Drainage Commissioners shall appoint a competent person as superintendent of construction. Such person shall furnish a bond, to be approved by the commissioners, in the penal sum of ten thousand dollars, conditioned upon the honest and faithful performance of his duties, such bond to be in favor of the board of drainage commissioners.

SEC. 21. The board of drainage commissioners shall cause notice to be given for two consecutive weeks in some newspaper published in the county wherein such improvement is located, if such there be, and such additional publication elsewhere as they may deem expe-

dient, of the time and place of letting the work of construction of said improvement, and in such notice they shall specify the approximate amount of work to be done and the time fixed for the completion thereof; and in the date appointed for the letting, they, together with the superintendent of construction, shall convene and let to the lowest responsible bidder, either as a whole or in sections, as they may deem most advantageous for the district, the proposed work. No bid shall be entertained that exceeds the estimated cost, except for good and satisfactory reasons it shall be shown that the original estimate was erroneous. They shall have the right to reject all bids and advertise again the work, if in their judgment the interest of the district will be subserved by doing so. The successful bidder shall be required to enter into a contract with the board of drainage commissioners and to execute a bond for the faithful performance of such contract, with sufficient sureties, in favor of the board of drainage commissioners for the use and benefit of the levee or drainage district, in an amount equal to twenty-five per centum of the estimated cost of the work awarded to him.

SEC. 22. The superintendent in charge of construction shall make monthly estimates of the amount of work done, and furnish one copy to the contractor and file the other with the secretary of the board of drainage commissioners against such contractor and his bond five days after the filing of such estimate, meet and direct the secretary to draw a warrant in favor of such contractor for ninety per centum of the work done, according to the specifications and contract; and upon the presentation of such warrant, properly signed by the chairman and secretary, to the treasurer of the drainage fund, he shall pay the amount due thereon. When the work is fully completed and accepted by the superintendent he shall make an estimate for the whole amount due, including the amounts withheld on the previous monthly estimates, which shall be paid from the drainage fund as before provided.

SEC. 23. If any contractor to whom a portion of said work shall

have been let shall fail to perform the same according to the terms specified in his contract, action may be had in behalf of the board of drainage commissioners against such contractor and his bond in the Superior Court for damages sustained by the levee or drainage district, and recovery made against such contractor and his sureties. In such an event the work shall be advertised and re-let in the same manner as the original letting.

SEC. 24. In the construction of the work the contractor shall have the right to enter upon the lands necessary for this purpose and the right to remove private or public bridges or fences and to cross private lands in going to or from the work. In case the right-of-way of the improvement is through timber the owner thereof shall have the right to remove it, if he so desires, before the work of construction begins, and in case it is not removed by the landowner it shall become the property of the contractor and may be removed by him.

SEC. 25. Where any public ditch, drain or water course established under the provisions of this act crosses a public highway the actual cost of constructing the same across the highway or removing old bridges or building new ones shall be paid for from the fund of the drainage district. Wherever any highway within the levee or drainage district shall be beneficially affected by the construction of any improvement or improvements in such district it shall be the duty of the viewers appointed to classify the land to give in their report the amount of benefit to such highway, and notice shall be given by the Clerk of the Superior Court to the Board of Commissioners of Roads and Revenues, or if there be no such board, to the Ordinary of the county where the road is located of the amount of such assessment, who shall have the right to appear before the court and file objections, the same as any land owner.

SEC. 26. Whenever the engineer and the viewers in charge shall make a survey for the purpose of locating a public levee or drainage district or changing a natural water course, and the same would cross the right of way of any railroad company, it shall be the duty of

those in charge of the work to notify the railroad company, by serving written notice upon the agent of such company or its lessee or receiver, that they will meet the company at the place where the proposed ditch, drain or water course crosses the right of way of such company, said notice fixing the time of such meeting, which shall not be less than ten days after the service of same, for the purpose of conferring with said railroad company with relation to the place where and the manner in which such improvement shall cross such right of way. When the time shall arrive fixed for such conference, unless for good cause more time is agreed upon, it shall be the duty of the viewers in charge and the railroad company to agree, if possible, upon the place where and the manner and method in which such improvement shall cross such right of way. If the viewers in charge and the railroad company can not agree, or if the railroad company shall fail, neglect or refuse to confer with the viewers, they shall determine the place and manner of crossing the right of way of said railroad company, and shall specify the number and size of openings required, and the damages, if any, to said railroad company, and so specify in their report. The fact that the railroad company is required by the construction of the improvement to build a new bridge or culvert or to enlarge or strengthen an old one shall not be considered as damages to said railroad company. The engineer and viewers shall also assess the benefits that will accrue to the right of way, road-bed and other property of said company by affording better drainage or a better outlet for drainage, but no benefits shall be assessed because of the increase in business that may come to said railroad because of the construction of the improvement. The benefits shall be assessed at a fixed sum, determined solely by the physical benefit that its property will receive by the construction of said improvement, and it shall be reported by the viewers as a special assessment, due personally from the railroad company as a special assessment; it may be collected in the manner of an ordinary debt in any court having jurisdiction.

SEC. 27. The clerk of the Superior Court shall have notice served upon the railroad company of the time and place of the meeting to hear and determine the final report of the engineer and viewers, and the said railroad company shall have the right to file objections to said report and to appeal from the findings of the board of commissioners in the same manner as any landowner. But such an appeal shall not delay or defeat the construction of the improvement.

SEC. 28. After the contract is let and the actual construction is commenced, if the work is being done with a floating dredge, the superintendent in charge of construction shall notify the railroad company of the probable time at which the contractor will be ready to enter upon the right of way of said road and construct the work thereon. It shall be the duty of said railroad to send a representative to view the ground with the superintendent of construction and arrange the exact time at which such work can be most conveniently done. At the time agreed upon the said railroad company shall remove its rails, ties, stringers and such other obstructions as may be necessary to permit the dredge to excavate the channel across its right of way. The work shall be so planned and conducted as to interfere the least possible manner with the business of said railroad. In case the railroad company refuses and fails to remove its track and allow the dredge to construct the work on its right of way it shall be held as delaying the construction of the improvement, and such company shall be liable to a penalty of twenty-five dollars per day for each day of delay, to be collected by the board of drainage commissioners for the benefit of the drainage district as in the case of other penalties. Such a fine may be collected in any court having jurisdiction and shall inure to the benefit of the drainage district. Within thirty days after the work is completed, an itemized bill for the actual expenses incurred by the railroad company for opening its tracks shall be made and presented to the superintendent of construction of the drainage improvement. Such bill, however, shall not include the cost of putting in a new bridge or strengthening or enlarging an old one. The superintendent of construction shall audit this bill and, if

found correct, approve the same and file it with the secretary of the board of drainage commissioners. The commissioners shall deduct from this bill the cost of the excavation done by the dredge on the right of way of said railroad company at the contract price, and pay the difference, if any, to said railroad company.

SEC. 29. Whenever any improvement constructed under this act is completed it shall be under the control and supervision of the board of drainage commissioners. It shall be the duty of the said board to keep the levee, ditch, drain or water course in good repair, and for this purpose they may levy an assessment on the lands benefited by the construction of such improvement in the same manner and in the same proportion as the original assessments were made, and the fund that is collected shall be used for repairing and maintaining the ditch, drain or water course in perfect order: Provided, however, that if any repairs are made necessary by the act or negligence of the owner of any land through which such improvement is constructed or by the act or negligence of his agent or employee, or if the same is caused by the cattle, hogs or other stock of said owner, employee or agent, then the cost thereof shall be assessed and levied against the lands of said owner alone, to be collected by proper suit instituted by the drainage commissioners. It shall be unlawful for any person to injure or damage or obstruct or build any bridge, fence or flood gate in such a way as to injure or damage any levee, ditch, drain or water course constructed or improved under the provisions of this act, and any person causing such injury shall be guilty of a misdemeanor, and upon conviction thereof may be fined in any sum not exceeding twice the damage or injury done or caused.

SEC. 30. The owner of any land that has been assessed for the cost of the construction of any ditch, drain or water course, as herein provided, shall have the right to use the ditch, drain or water course as an outlet for lateral drains from said land; and if said land is separated from the ditch, drain or water course by the land of another or others, and the owner thereof shall be unable to agree with said

other or others as to the terms and conditions on which he may enter their lands and construct said drain or ditch, he may file his ancillary petition in such pending proceeding to the court, and the procedure shall be as now provided by the law. When the ditch is constructed it shall become a part of the drainage system and shall be under the control of the board of drainage commissioners and be kept in repair by them as herein provided.

SEC. 31. After the classification of the land and the ratio of assessment of the different classes to be made thereon has been confirmed by the court, the drainage commissioners shall prepare an assessment roll or drainage-tax duplicate, giving a description of all the land in said drainage district, the name of the owner, so far as can be ascertained from the public records, and the amount of assessment against each of the several tracts of land. In preparing this assessment roll the board shall ascertain the total cost of the improvement, including the damages awarded and to be paid to the owners of land, and all incidental expenses, and deduct therefrom any special assessment made against any railroad or highway, and the remainder shall be the amount to be borne and paid by the lands benefited. This amount shall be assessed against the several tracts of land according to the benefit received, as shown by the classification and ratio of assessment made by the viewers and confirmed by the board of drainage commissioners. This drainage tax-roll shall be made in duplicate, signed by the chairman and secretary, and one copy filed with the drainage record and the other delivered to the sheriff or other county tax collector. There shall be appended an order to collect the said assessments, and the same shall have the force and effect of a judgment as in the case of State and county taxes.

SEC. 32. If the total cost of the work is less than an average of twenty-five cents per acre on all the land in the district the assessment made against the several tracts shall be collected in one installment, by the same officer and in the same manner as State and county taxes are collected, and payable at the same time. In case the total

assessment exceeds the average of twenty-five cents per acre on all the lands in the district the said board of drainage commissioners may give notice of three weeks by publication in some newspaper of general circulation in the district, if there be one, and also by posting a written or printed notice at the door of the court house and at five conspicuous places in the drainage district, that they propose to issue bonds for the construction of said improvement, giving the amount of bonds to be issued, the rate of interest they are to bear and the time when payable. Any landowner having lands assessed in the district and not wanting to pay interest on the bonds may, within thirty days after the publication of said notice, pay the county treasurer the full amount of his assessment and have his land released therefrom.

SEC. 33. Each and every person owning land in the district which is assessed for the construction of an improvement who shall neglect or fail to pay the full amount of his assessment to the county treasurer within the time specified shall be deemed as consenting to the issuing of said drainage bonds, and in consideration of the right to pay his assesment in installments he hereby waives his right to any defense against the collection of said assessments because of any irregularity, illegality or defect in the proceedings prior to this time, except in the case of an appeal, a heretofore provided, which is not affected by this waiver. The term "person" as used in this act, includes any firm, company or corporation.

SEC. 34. At the expiration of the thirty days after the publication the board of drainage commissioners may issue bonds for the full amount of the assessment not paid in to the county treasurer, together with the interest thereon, costs of collection or other incidental expenses. These bonds shall bear six per cent. interest per annum, payable annually, and shall be paid in ten equal annual installments. The first installment of the principal shall mature at the expiration of three years from the date of issue, and one installment each succeeding year for nine additional years. The commis-

sioners may sell these bonds at not less than par and devote the proceeds to the payment of the work as it progresses. In no case shall bonds be issued until the tax levy has been made to meet them as they come due. The bonds issued shall be for the exclusive use of the levee or drainage district specified on their face, and should be numbered by the board of drainage commissioners and recorded in the drainage record, which record shall set out specifically the lands embraced in the district on which the tax has not been paid in full, and which land is assessed for the payment of the bonds issued and the interest thereon. This assessment shall constitute the first and paramount lien, second only to State and county taxes, upon the lands assessed for the payment of said bonds and the interest thereon as they become due, and shall be collected in the same manner by the same officers as the State and county taxes are collected. If any installment of principal or interest represented by the said bond shall not be paid at the time and in the manner when the same shall become due and payable, and such default shall continue for a period of six months, the holder or holders of such bond or bonds upon which default has been made may have a right of action against said drainage district or the board of drainage commissioners of said district, wherein the court may issue a writ of mandamus against the said drainage district, its officers, including the tax collector and treasurer, directing the levying of a tax or special assessment as herein provided, and the collection of same, in such sum as may be necessary to meet any unpaid installments of principal and interest and cost of action; and such other remedies are hereby vested in the holder or holders of such bond or bonds in default as may be authorized by law; and the right of action is hereby vested in the holder or holders of such bond upon which default has been made authorizing them to institute suit against any officer on his official bond for failure to perform any duty imposed by the provisions of this act. The official bonds of the tax collector and county treasurer shall be liable for the faithful performance of the duties herein assigned them. Such bonds may be increased by the board of county commissioners.

SEC. 35. Where the court has confirmed an assessment for the construction of any public levee, ditch or drain, and such assessment has been modified by the court of superior jurisdiction, but for some unforeseen cause it cannot be collected, the board of drainage commissioners shall have power to change or modify the assessment as originally confirmed to conform to the judgment of the Superior Court and to cover any deficit that may have been caused by the order of said court or unforeseen occurrence. The said relevy shall be made for the additional sum required, in the same ratio on the lands benefited as the original assessment was made.

SEC. 36. Any engineer employed under the provisions of this act shall receive such compensation per diem for his services as shall be fixed and determined by the Drainage Commissioners. The viewers, other than the engineer, shall receive three dollars per day; the rodmen, axmen, chainmen and other laborers shall receive not to exceed two dollars per day each. All other fees and costs incurred under the provisions of this act shall be the same as provided by law for like services in other cases. Said costs and expenses shall be paid, by the order of the court, out of the drainage fund provided for that purpose, and the board of drainage commissioners shall issue warrants therefor when funds shall be in the hands of the treasurer.

SEC. 37. In the event that the United States Government makes provisions for loans to prosecute drainage and reclamation work or provides for such work to be done under the supervision of its officials, the drainage commissioners for districts created under this Act are empowered to avail themselves of such provision at any time by co-operating with the said United States Government officials for the completion of any work begun prior to such provision being made, and said drainage commissioners are empowered to levy and collect in the manner herein provided the taxes against the land and to pledge any pay the receipts from such levy in liquidation of the loan made as aforesaid by the United States Government; and it shall be the duty of the State Geologist of this State to co-operate and solicit

the co-operation of the various bureaus of the United States Government, in the prosecution of all work undertaken under this Act.

SEC. 38. The provisions of this Act shall be liberally construed to promote the leveeing, ditching, draining and reclamation of wet and overflowed lands. The collection of the assessment shall not be defeated, where the proper notices have been given, by reason of any defect in the proceedings occurring prior to the order of the court confirming the final report of the viewers; but such order or orders shall be conclusive and final that all prior proceedings were regular and according to law, unless they were appealed from. If on appeal the court shall deem it just and proper to release any person or to modify his assessment or liability, it shall in no manner affect the rights and legality of any person other than the appellant, and the failure to appeal from the order of the court within the time specified shall be a waiver of any illegality in the proceedings, and the remedies provided for in this Act shall exclude all other remedies.

SEC. 39. Proceedings under this Act may be ex parte or adversary. Any engineer, viewer, superintendent of construction or other person appointed under this Act may be removed by the court, upon petition, for corruption, negligence of duties or other good and satisfactory cause shown.

SEC. 40. This Act shall take effect from and after its passage and shall not repeal or change the law contained in Vol. 1, Code of Georgia 1911, on the subject of drainage, but shall be cumulative thereto, nor shall it affect any local drainage system established thereunder.

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